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ABSTRACT

Issues concerning the conditions of college facilities are considered in 29 papers from the 1985 annual meeting of the Association of Physical Plant Administrators of Universities and Colleges. Papers and authors include: "Crumbling Academe" (Harvey H. Kaiser); "Physical Facilities Evaluation" (Henry L. Shelby); "Managing the Process of Facility Management" (Kenneth A. Hall); "Managing Non-HVAC Routine Maintenance" (Paul Biggers); "Making Computer Decisions" (Shelly K. Merrill); "Procedures for Manpower Scheduling" (Paul F. Tabolt); "Bottom-Up Capital Budgeting" (Robert H. Clawson); "Facilities Management Down Under" (William J. Humble, Maurice R. Pawsey); "Chilled Water Storage" (Miklos G. Kurz); "Local Area Networks" (Mohammad H. Qayoumi); "Nuts and Bolts of the Plant Personnel Team" (Barbara Kunz); "Buying Direct Digital Controls" (Gary L. Reynolds, John P. Sluis); "Planning a Preventive Maintenance Program" (Richard L. Orton); "Asbestos: A Hazard Identification and Training Plan for Colleges and Universities" (Harry Kriemelmeyer, William J. Lopes); "Leadership: The Difference" (Jerry Boyea); and "Selecting and Working with Architectural and Engineering Consultants" (John M. Davis). (SW)

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Proceedings of

The Seventy-Second Annual Meeting of The Association of Physical Plant Administrators of Universities and Colleges

Professionals Working Together

ED264775

Vice President for Educational Programs:
Jack Hug, University of California/San Diego

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In Appreciation

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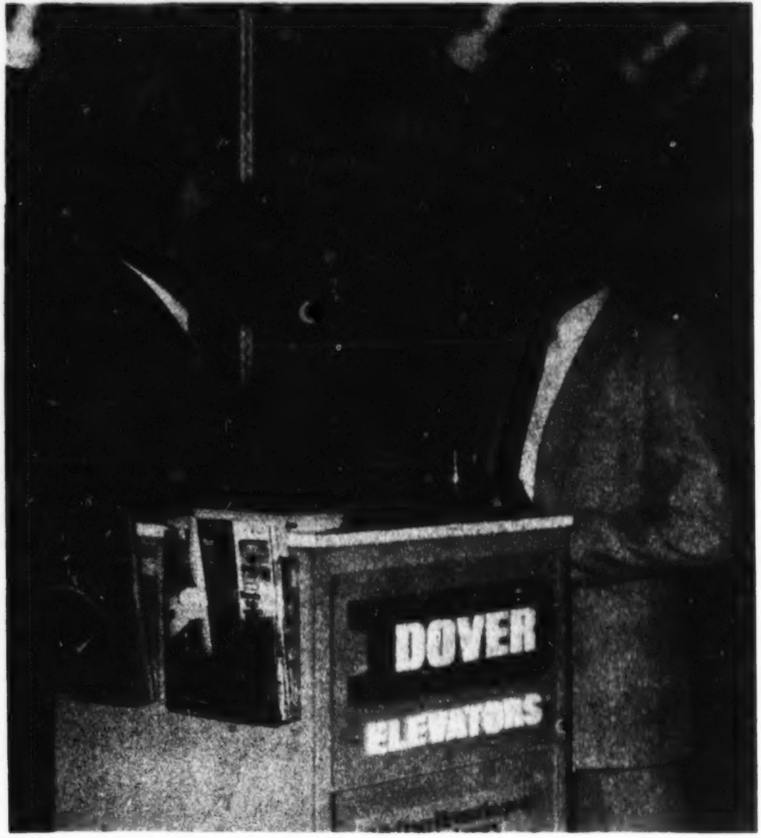
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Thursday, July 11, 1985

Harvey H. Kaiser

CRUMBLING ACADEME

Keynote Address

72nd Annual Meeting

Association of Physical Plant Administrators
of Universities and Colleges

July 11, 1985

Introduction

I am pleased to introduce this 72nd Annual Meeting of the Association of Physical Plant Administrators. "Crumbling Academe" is a provocative title for a book as well as a talk to an annual meeting dedicated to "professionals working together". Especially when the focus is the physical plants that are crumbling.

How severe are the conditions of academe's facilities? On a national and state-wide basis, the disturbing answer is an unclear picture of sparse data. On a local basis, many of you do know the condition of your facilities. So do the faculty, staff, students, and alumni. You can identify the priorities, the costs, and schedules for remedial action. Some of you have been involved or are currently planning programs to correct the major deficiencies of your buildings, grounds, utilities, and equipment.

Call it deferred maintenance, repairs and renovations, or renewal and replacement, or whatever best fits your needs. The problems are real. They affect the ability of your institution to perform missions of teaching, research, and community service and, just as critically, the conditions affect the attractiveness to future students, faculty, and potential donors.

How real are today's plant problems? Are the pervasive leaky roofs, cracked sidewalks, peeling window frames, dripping steam valves, and ineffective heating and cooling systems of a magnitude beyond "normal" funding in Education and General Budgets?

The answer is a resounding and frightening Yes! The problems do exceed the capacity of annual maintenance procedures and funding.

Causes and responsibilities for today's problems are not as important as solutions: how to attack the problem by developing awareness and constituencies of support, determining conditions and priorities, estimating funding needs, and securing necessary funding. And that's essentially what I want to talk about with you this morning. That, and some brief comments on the environment you are now working in and most probably will be engaged in for the rest of this century.

Issues

Briefly, let me describe the extent of the problem. The last national survey of facilities, conducted in 1974, estimated that twenty percent of higher education's facilities on over 3,000 campuses were in need of renewal and replacement. Since then, no national survey has been conducted. However, the impacts of energy costs, enrollment stability or declines, and federal and state levels of appropriations over the past decade suggest that funding for plant operations and maintenance has not increased. Furthermore, in only isolated examples have there been enlightened programs of funding renewal and replacement.

All of this adds up to an estimate of $40 to $50 billion for higher education facility renewal and replacement for a plant of 2.3 billion square feet with a replacement value of over $200 billion.

In an effort to refine this estimate, I have initiated a national survey of facility conditions and funding needs. The purpose is to assist in public policy formulation and support public systems of higher education and individual campuses in presenting their cases to legislative bodies and governing boards. A disturbing feature of the responses is that less than half of the state coordinating boards collect comprehensive data on facility conditions, replacement values, and renewal and replacement needs. Little of this data includes independent campuses. Less than ten states collect data that can intelligently inform legislative bodies of funding needs to aid in developing renewal and replacement funding programs.

Some selected examples of my preliminary data collection are:

North Carolina (1982)

- Total statewide public and independent enrollment of 230,000 students.
- Total space of 72 million gross square feet.
- Satisfactory condition: 82.0%.
- Estimated cost of restoring to satisfactory condition: $301 million.

University of California System (1983)

-60 million gross square feet of space.
-Capital maintenance backlog of $2 billion at $33.30/gross square foot.

Texas College and University System (1983)

-1982 survey of 28 institutions, excluding University of Texas (Austin) and Texas A&M, only E & G space ten years and older and more than 10,000 gsf.
-Total costs for repair and rehabilitation for 21.3 million gsf at $301 million; $213.4 million for repair and replacement, and $63.5 million for life safety and environmental protection.

Iowa (1984)

-Three campuses with headcount enrollment of 67,000.
-25 million gsf with a $2 billion replacement value.
-A $280 million ten-year renewal and replacement program.

Kansas (1980)

-52 public and independent four- and two-year campuses.
-Total enrollment of 134,000; space of 29.6 million gsf and replacement value of $2.4 billion.
-Critical needs for renewal and replacement of $60.5 million.

Indiana (1983)

-28 four- and two-year campuses with 33.6 million gsf.
-Replacement value of $3.34 billion.
-76% in satisfactory condition and 53% 20 years or older.

Arkansas (1984)

-73,000 students in public and independent four- and two-year campuses.
-Of 8.3 million gsf E & G space with 40.7% in excellent condition; 40% built in last 10 years.
-Deferred maintenance estimated at $60.8 million with actual needs of $13.2 million.

Ohio (1984)

- Enrollment of 304,000 at 38 public four- and two-year campuses.
- Total space of 73 million gsf.
- Estimated five-year renewal and replacement program of $1.1 billion with $265 million in first year critical needs.

Columbia University (1984)

- 7.11 million gsf.
- Capital maintenance backlog of $247 million at $34.80/gsf.

Syracuse University (1970-1985)

- 7.1 million gsf.
- Completing a 15-year renewal and replacement program of over $170 million with $90 million in replacement and $80 million in renovations.

One other component of facility needs beginning to draw national attention is research and science and technology space and scientific instrumentation. A recent survey of the American Association of Universities reported equipment in the nation's leading research universities is twice as old as that used in prominent industrial research laboratories. Because of the obsolete or inadequate nature of many of our laboratories for teaching and research, measures are now being introduced into Congress for funding this vital component of our campuses. Your support through determining needs and priorities to develop policies for implementation can assist in gaining the appropriate funds.

The research and instrumentation issue has a direct bearing on the overall nature of crumbling academe. Because of the relationship to natural defense and the economy, the subject has caught the attention of Congress and the news media. A similar event is going on with the nation's infrastructure needs. More must be done to gain awareness about facility conditions and funding needs.

Legislative bodies, governing boards, and campus administrators share in a common stewardship of higher education. That word - stewardship - has lofty connotations. It is at the core responsibility of those elected officials, appointed trustees, and current campus administrators: to transmit knowledge, create scholarship, and intellectually prepare students, and, incidentally, assure that resources are available to conduct an institution's mission.

The physical resources - the buildings, grounds, utilities, and equipment - that are in need of attention, require a concentrated effort to:

- --Assess the extent of the renewal and replacement backlog nationally, statewide, and at the campus level.
- --Develop methods of inventorying campus conditions and selecting priorities.
- --Determine funding needs.
- --Evaluate appropriate financing strategies for renewal and replacement priorities.
- --Propose policy recommendations for securing financial support of higher education's renewal and replacement needs.

A final point on "issues". It is of little benefit to seek cause or personal responsibility for the current condition of campus facilities. Because of the stigma attached to culpability, there is a reluctance in some quarters to stand up and admit that deterioration exists and substantial funding is necessary to correct problems. The anticipated wrath of legislators, faculty, and alumni is intimidating. For that reason, we often see a "new broom" in campus administration leading the request for an inventory of facilities, priorities, and costs, setting aside the sins of their predecessors.

In my view, the courage of an incumbent to create a program inventorying needs and estimating priorities is more laudable than the alternative of acknowledging the problems and not pressing the issue for fear of repercussions. Who better knows the plant, its problems, and its needs than the experienced administrator? And who better than the physical plant administrator to press for the resources to conduct the inventories and define the funding needs?

The Plant Administrator's Future Environment

Within the context of renewal and replacement, the changing role of your profession and the nature of the future environment you will be working in are worthy of note.

The name of this Association bears "Physical Plant" proudly as the identity of your professions. That is what you administer and how you have become accustomed to being identified. But some time in the past decade, a subtle change has occurred. Words like "facilities", "management", and "administration" are being introduced to describe responsibilities and skills that go beyond traditional maintenance. All this has come about as institutions and private corporations recognize the importance of their physical assets. More complex demands on space, environmental concerns, and changing technologies have brought about the recognition that facilities ought to be managed.

Indeed, APPA's fine new reference book, Facilities Management: A Manual for Plant Administrators, illustrates the subtlety of the change.

Moving from basic responsibilities for operations and maintenance, the new facility administrator-manager is acquiring an expanded role: in property management, to guide decisions to buy, sell, lease, or build; in facilities planning, to guide long-range planning, space allocations and utilization, and coordination of facility changes and internal relocations; and in fiscal controls and management information systems, to guide in managing campus fiscal resources.

The "new" facility manager will be facing the following challenges, along with traditional responsibilities, for the balance of this century:

--An era of conservation of resources with modest growth in facilities, symbolized by reassessment of curriculum and teaching.

--A heightened sense of stewardship as campuses redefine missions and strengthen their historic continuity in the face of stable or declining enrollment and resources.

--Greater collegial involvement in decisions regarding plant and allocation of resources as campus administrators strive for academic excellence and attractiveness for current and future faculty, staff, and students.

- --Increasing attention to preservation of existing facilities with a view towards flexibility conducive to change rather than growth.

- --Facility improvements for traditional disciplines and accommodating changing technologies and environmental concerns.

- --Facilities for high growth pre-professional disciplines, such as business and computer sciences.

- --Improving the quality of student life through renovations and additions to residence halls, dining facilities, and student centers.

- --Greater involvement by campus constituencies and surrounding community in facility decisions.

Finally, and possibly the most important challenge, is the demand for leadership in managing campus facilities. The ability to participate in policy-making with a full knowledge of the existing plant, the technical skills to offer advice and counsel, and initiative in identifying problems and seeking solutions in a collegial atmosphere will be fundamental attributes for survival in the challenging future environment.

An Institutional Plan of Action

Returning now to the central theme of renewal and replacement I offer the following seven-point program for institutional action.

1) First, is the need to develop a CAMPUS CONSTITUENCY OF SUPPORT. The problems of renewal and replacement may already have been brought home by a restive faculty, staff, or student body. The alumni may have questioned the shabby condition of Old Main, Carnegie Library, or Alumni Hall. Or leaky roofs, defective plumbing, or obsolete laboratories caused the shutting down of space. Through the physical plant administrator's leadership, the creation of a constituency in the form of a task force provides the voices of support when priorities are selected and funding needs defined. Not a committee to defer action, but one that is a constituency of support to achieve stated goals for renewal and replacement.

When the time comes to select priorities between major maintenance and academic improvements, voices of the campus chief executive officer and academic and business officers should have been heard in private consultation. Their participation in farming a physical plant task force, agreeing to endorse recommendations and pledges of pursuing funding, augur success for proposals. Without their participation and determination to develop renewal and replacement policies, an essential element of the campus constituency has been avoided unnecessarily and a program potentially doomed to failure. The caveat is to engage campus leadership early in the process, incorporate faculty, staff, and trustee representatives in decision-making. Maintain credibility, be thorough in preparation, gain a sympathetic senior administrator's support, and be prepared for implementation.

2) The second point is developing a WORK PLAN defining a timetable and costs for inventorying facility conditions. Two critical decisions are involved: first, defining the scope of the audit, and second, selecting the inventory team.

Defining the scope means determining the extent of the inventory: whether to include all buildings, grounds, utilities, and equipment or only a selection; whether to conduct a comprehensive or a condensed facilities audit. For some institutions this represents an opportunity for basic data collection for all facilities, including descriptions of building systems and equipment, original contract documents, and maintenance histories. For others, this will form an outline for the updating of previously collected data.

Staffing of the audit team is an important decision. A member of the institution should be designated team leader with overall responsibility for determining scope, schedules, and assignments. Outside expertise may be necessary to augment campus staff or consultants retained to perform the entire audit. If consultants are retained, a campus staff member should be on the team to provide continuity with the audit and implementation. It is also important for consistency of evaluations to have the entire team visit a facility simultaneously and daily record its observations.

Part of the audit work plan is tying the inventory into a five- or ten-year plan coordinating renewal (elimination of deferred maintenance) and replacements (new construction, additions or major renovations) with regular operations and maintenance. This approach helps in the later process of selecting priorities, bringing together major maintenance with academic improvements.

3) The third point in the institutional plan of action is the CONDITION INVENTORY, THE FACILITIES AUDIT. The Facilities Audit Workbook, published by APPA, is a suggested guide for a self-evaluation process. The Workbook offers a framework for defining physical conditions and functional adequacy of campus facilities. It also produces a record of building characteristics and use, a record of existing conditions, an overall facility rating, comments on maintenance requirements, and identifies repair and replacement needs.

The facility audit concept breaks the building down into four physical categories and their components: 1) primary structure - the exterior envelope; 2) secondary systems - interior construction and finishes; 3) service systems - heating , ventilation, air conditioning, plumbing, and electrical; and 4) safety standards. These categories can be coupled with an energy audit. A fifth category provides a building functional analysis.

At the completion of an audit, the condition rating of components can be translated into order of magnitude costs for correcting deficiencies using building replacement values. Further refinement occurs with estimates for labor and materials for specific projects.

Again, the audit provides a thorough record of existing conditions, identifies regular maintenance items and major repair and replacement projects. The data enables comparison of conditions between campus buildings on other campuses, a useful tool for policy formulation.

4) The next step, point four, is PRIORITY SELECTION. An art or science, politics or pragmatism? A little of each is the answer.

Capital renewal and replacement priority selection faces similar temptations occurring when developing annual operating budgets. The pie is only so large and there are only so many pieces to go around. No doubt about it, this is a political environment of satisfying short-term needs in contrast with long-term institutional goals. In addition to technical input of the facilities audit, there are intangible factors: the influence of legislators and donors, the needs and views of distinguished campus academicians, the personal preferences of senior administrators, and community interests. Overcoming traditional budgeting practices and resolving intangible factors requires clear policy guidelines and procedures.

Some public systems and independent campuses have declared moratoriums on new construction. Inevitably, either through the results of facility audits, innovations in academic programs, or the desire to improve the quality of student life, some new construction will occur.

A framework for priority selection suggested by Richard Dober describes projects as: compelling need or calculated risk; those that must absolutely be done and those that can be deferred because they are less compelling.

There are three levels in a system of priority selection:

--Necessary projects: hazardous life and safety conditions, immediate repairs to prevent a facility's loss of service, legal compliance; and cost effective measures.

--Deferrable projects: repairs, renovations, and other physical plant improvements less urgent then necessary projects, and actions anticipating long-term goals, e.g. land acquisitions, utility or road improvements, and advance planning for capital projects.

--Decrease in scope and cost: reducing project scope to a smaller scale or using materials and systems with a lower life expectancy.

An approach to selecting priorities is the concept of decision packages: combining projects in a building for efficiency rather than by strict ranking of priority. For example, a high priority of roof repairs should not ignore lower priorities for other parts of the same building. The possibilities of combining work on several systems that share construction sequences, such as scaffolding, can be more economical by combining less significant priorities into larger projects. It is possible to count across several priority levels, combining life safety work and cost-effective measures with academic improvements. Thus a high priority of safety measures in a laboratory can be combined with lower priority mechanical systems, lighting, or interior finishes.

As campuses place limits to new construction and turn to renovating existing space, the difficult question arises of renewal versus replacement. Renovating a structure to satisfy needs for a projected life of 50 to 75 years should question: What levels of renovation are possible? Can work be phased to allow use during renovation? Can equivalent funds be spent more wisely to rehabilitate other space?

Can proposed academic and other institutional needs be better accommodated with complete replacement of the existing building? In some cases, one must weigh the advantages of renewing an existing structure, even at premium costs.

Apart from the question of historic, architectural, or sentimental value, the renewal or replacement decision involves a host of practical considerations: Can the older building really be saved by renewal? Can financial support be attracted for a renewal rather than a replacement? Will the results of building renewal be functionally and esthetically successful?

The advice of the Educational Facilities Laboratories of over twenty years ago stands well today:

> "... colleges would do well to look twice at their old buildings before deciding to tear them down. To spare the wrecker's axe may be to spare the budget. A good rule of thumb may be to renovate if the building is where it belongs, is structurally sound, and possesses beauty, however ancient. If the building is in the wrong place, if its interiors are practically unchangeable, if is is ugly, abandon it."

5) The fifth point, FUNDING REQUIREMENTS FOR CAPITAL RENEWAL AND REPLACEMENT, answers the question: How much is enough? As easy as the answer, "enough to complete the job", may sound, the various streams of funding sources make the accurate response more complex. The important principle for policy makers to remember is that a one-time elimination of current renewal and replacement priorities does not solve the problem. As campus facilities continue to deteriorate and become obsolete, an annual allocation for capital renewal and replacement may be necessary to prevent future accumulation of deferred maintenance. Establishing an appropriate level of annual funding in the beginning of a program may have to include "catch-up" costs. As needs are reduced to manageable proportions, the operating budget can accommodate priorities as they are identified. The end result is a program that maintains campus facilities in good repair, so they are functionally adequate for teaching, research, campus life, and public service.

A recommended level for renewal and replacement in the annual current fund budget, separate from operations and maintenance, is one and one-half to three percent of total plant replacement value. This guideline fits with the general rule of a fifty-year depreciation for facilities and is refined by life-cycle concepts.

Stanford University evolved a detailed life cycle model by using a predictable life for replacement of 119 building systems and components. By predicting when replacement cycles would occur, the model timing and costs approximated the annual reinvestment necessary to maintain the physical plant. However, use of a range of percent of total replacement value should not overlook existing conditions. Deferred maintenance will require adjustments to replacement cycle estimates and recommendations for capital funding to bring facilities into a "new" condition when forecasting realistic levels of annual funding renewal and replacement. Typically, funding for capital renewal and replacement comes from operating budget residuals, if available; which is how most institutions reached their current levels of deferred maintenance. Rather, they should establish an appropriate level of funding in the operating budget to help prevent the continuing deterioration and obsolescence of facilities and equipment.

Addressing the capital renewal and replacement needs with life cycle or depreciation concepts offers institutions an opportunity for comprehensive facilities management. Once management has formally identified the useful lives of buildings and equipment, it can better measure the appropriate funding levels and plan for renovating and replacing them.

6) My sixth point, FUNDING SOURCES, strikes directly at the question: Where will the money come from? The faith that plant replacement funding would come from government largesse or from private gifts and grants has proven to be a myth, except in rare cases.

After all the funds have been wrung out of unrestricted gifts and gifts restricted to plant, and after all the plant funds have been drained of resources, there are only three sources to turn to for financing capital renewal and replacement: 1) the operating budget; 2) assets which can be converted; and 3) external sources. Stated succinctly, this means managing the current fund for greatest effectiveness, re-examining current assets, and raising money from gifts, grants, and long-term financing.

Because colleges and universities have been adjusting to the cost-income squeeze since the early 1970's, the limited flexibility in most institutional budgets cannot be overlooked. Many institutions have already reduced the size of their operations, reallocated resources internally, and retrenched faculty, staff, and programs to shrink the budget base. In fact, the reduction in expenditures in higher education to offset worsening financial conditions in the past decade has been accomplished at the expense of staff compensation and deferred maintenance, making reports of "balanced budgets" highly deceptive. Introducing an annual level of renewal and replacement funding as a new item in the operating budget therefore requires fresh financial resources.

The contribution of the physical plant administrator here comes from managing for performance. By seeking productivity gains through an audit of procedures, introducing work order systems, data automation and continuing energy conservation, savings can be achieved for transfer to renewal and replacement funding. Various consultants estimate, with fair credibility, that rationalizing maintenance procedures can generate savings of one-quarter to one-third in maintenance budgets.

The physical plant administrator can also contribute in the more traditional areas of fund-raising. Creative approaches of treating renewal and replacement in similar terms as academic endowments or new construction requires accurate cost estimates, feasibility studies, and implementation plans. Examples of renovation projects grouped into an overall campaign or independently as a separate campaign have shown recent successes.

Capturing the imagination of potential donors requires thoroughness and creativity in proposal preparation. At the core of the proposal is a clear statement of the activity benefitting from the gift. The appeal to the donor must emphasize that an essential academic program, not just the building, will be enhanced by the proposed renovation work. Reluctance to seek funds for a roof replacement or leaking plumbing in a chemistry building can be reshaped by highlighting the importance to undergraduate teaching or sustaining research activities. The message is that restoring facilities and equipment for academic programs is just as essential to the institution as providing space for new programs.

Conversion of assets, another source of funding, can be translated as "cleaning out the attic". Colleges and universities have long been the recipient of well intentioned gifts, sometimes with a pragmatic eye towards tax benefits, that can be considered expendable. Yale University sold its Brasher Daubloon for $675,000 and at Syracuse we sold an S.F.B. Morse painting recently for $3.2. million. Other campuses have quietly sold off buildings or gifts nonessential to their purposes. Land, especially with development potential, offers opportunity for sale or leasing.

The principles to heed are safeguarding gift restrictions and a cautious approach in using an institution's cash for investments. At Syracuse, a 250 room hotel, conference center, and garage was recently completed by a developer on University-leased land. A $150 million co-generation plant on University land is now being proposed by a developer that will reduce energy costs by 25 percent. These, and similar developer proposals, all require close scrutiny of sound legal and financial advice.

The rash of innovative techniques proposed by external sources addressed to the physical plant administrator, debt financing, investments, participation with development all should receive the same thorough legal and financial examination.

7) Creating PUBLIC AWARENESS is my seventh, and final point. The goal is a plan of action at the national and campus level to: maintain a functional, safe and attractive campus environment that enhances academic excellence; have the ability to attract and retain faculty, staff, and students; and gain external support.

A plan of action must address several fundamental questions:

- --What is the extent of capital renewal and replacement needs?
- --What are the appropriate national and campus policies for resource allocation?
- --What are the strategies for developing campus awareness and public policies for funding capital renewal and replacement?

The first step is to make legislators, governing boards, and campus administrators aware of this important issue. This can be achieved by incorporating capital renewal and replacement into overall institutional advancement programs. Awareness can be furthered by using existing or developing internal and external communications techniques for presentations to governing boards, administrators, faculty, staff, students, alumni, and local community. Finally, awareness of a broad base of the campus community will further renewal and replacement goals.

The enormity of the problem calls for concerted action at the national level: a national plan of action with a coalition of higher education associations representing trustees and administrators, elected and appointed government officials, and public system and independent sector representatives.

Why is such an effort needed? The nation's crumbling infrastructure and deferred maintenance around postsecondary institutions share a common problem: low visibility. This critical issue suffers from lack of public awareness. Working together, trustees, presidents, federal and state legislators, and private sector representatives could elevate capital renewal and replacement to a national agenda item. A coalition of education, government, and business leaders could muster strong and continuous media coverage.

Such a coalition might result in the creation of a national task force whose goals would include eliciting public support, influencing public policy, and encouraging increased action at the campus and state levels. These broad goals would be accomplished by a study containing the following components:

--Prepare national inventory and guide institutions in completing detailed inventories of capital renewal and replacement needs and priorities.

--Determine required levels of funding.

--Disseminate findings to legislative bodies, government agencies, national media, educational associations, and institutions.

--Prepare proposals for support to federal, state, and local government; corporations, and foundations.

At the campus level a plan of action should include the seven points previously described:

1. Campus Constituency of Support
2. A Work Plan
3. A Condition Inventory: The Facilities Audit
4. Priority Selection
5. Funding Requirements for Capital Renewal and Replacement
6. Funding Sources
7. Public Awareness

Conclusion

That wise old investor, showman Billy Rose, once said: "never put your money into anything that eats or needs painting". It is a principle that colleges and universities would like to follow - but cannot afford.

Repair and replacement needs vary by region, building type, the extent of use and abuse, and quality of original construction and maintenance. But as sure as death and taxes, building systems and components deteriorate and need replacement. Plumbing wears out, roofing leaks, window frames warp, patched-up electrical wiring becomes dangerous, heating systems fail to heat, and equipment parts can no longer be replaced. These are glamourous priorities, especially when reductions in staff and quality of academic programs are at risk.

Funding for capital renewal and replacement is not at the top of higher education's priority list. Nor has it aroused the attention of the public agencies, corporations, and foundations. Funds for capital renewal and replacement may seem less urgent in a decade where institutions struggle for mere survival. When weighed against declining student enrollment, reduction of faculty, and discontinued programs, capital renewal and replacement is often a low - or lowest - priority.

Realities of rectifying the deplorable conditions of many campus physical plants have been examined here and elsewhere. In order to correct the situation, governing boards, and administrators must take the initiative and work together to:

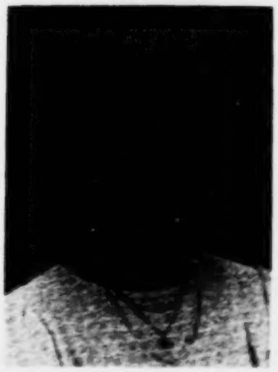
--Build constituencies of support.

--Accurately define the magnitude of capital renewal and replacement needs.

--Establish procedures of institutional resource allocation.

--Gain the support of public and private sources to fund capital renewal and replacement.

If institutions are to fulfill their mission now and in the coming decades, the capital renewal and replacement dilemma must be resolved. With the help of physical plant administrators across the country, it will be.



Sensitivity Training for the Professional Tradesman

Esther M. Geiermann
University of Cincinnati

The vast majority of Facilities Management tradesmen and women are highly skilled, well trained professionals who perform the technical aspect of the job very effectively. What the manager often fails to recognize, but what can be a real problem, is that most of these employees have never been exposed to any type of customer relations or sensitivity training. They are kept current on state-of-the-art technology, but not on the inherently difficult problem of communication. What a faculty member or a vice president's secretary perceives as being unprofessional behavior or, more often, an attitudinal problem is quite often only ignorance on the part of the employee as to the proper way to handle the situation. Once this is recognized, it is relatively simple to put together a program that can correct the behavior and turn around the campus community's image of the Facilities Management Department.

The first step is to determine the goals of your program. This will probably include: (1) Improving the employee's awareness of the importance of sensitivity. (2) Letting the people with whom you do business know that the Department of Facilities Management is a first-rate, professional organization. (3) Developing highly motivated, loyal employees.

The objectives required to achieve these goals would be:

1. To have the employee identify, understand and appreciate the need for training.

2. To employ simple, yet practical and effective techniques and procedures which will improve customer relations.

3. To give your employees the knowledge needed to be professional in all aspects of the job.

4. To implement a follow-up procedure for feedback concerning customer satisfaction.

Identifying The Need For Training.

When identifying the need for training it is best to avoid the use of an evaluative approach which will be perceived as an attack on the person. One effective technique would be the use of a video tape which describes embarrassing situations that have occurred on your campus. You don't want to limit your situations to only those at the job site, but should attempt to cover any situation that affects the image of the department. The tape could include anything that might occur from the time the employee leaves the shop until he leaves the work area, e.g., his driving, parking, the condition of the department vehicle, and possibly even the condition of the employee's uniform. You could incorporate into the script anything that you have identified as a significant problem within your department.

You want the situations included in your video tape to be humorous enough to capture the problem as it exists, but should always be kept in good taste. Your script might go somewhat like this. Joe Service leaves the shop in the department vehicle which obviously is in need of washing. As he drives through campus he fails to stop for students in a cross walk, when parked, the vehicle extends over the sidewalk forcing pedestrians into the street. As Joe enters the work site he might say something like, "I understand that someone in here is complaining about it being too hot--yesterday it was too cold." After a quick look at the equipment, Joe determines that it is not his area of expertise, so he picks up his tools and leaves the room without notifying anyone that the repair is the responsibility of another crew. As the script continues, Jane Service enters the area, starts to work on the job, then she too leaves, this time because additional parts are required. Again, without notifying anyone of the status of the job. Or Jane may complete the job, and even notify the customer that it is complete, but leaves behind debris, packing material or old parts.

Perhaps, another segment of your script might include the customer requesting additional work while the employee is in the area. Joe Service might respond in a surley manner with something like, "Nope, they tell me I can't do anything except what's written on this here work order., You gotta call work control again to get that done". However, this really can be a very threatening experience for the employee. A work request to paint one wall within an office where some minor remodeling has been done can end up with an on-the-spot request to paint the entire room or several rooms within the suite. How does the employee diplomatically refuse the request in your vice president's office? Your script can carry this one step further by depicting rude behavior by irate clients that the employee encounters while trying to perform the job.

The script could end with the Jane Service leaving an area with no indication of the job being completed or, in some instances, the customer never knowing that Facilities Management has responded to their work request.

Understanding The Need For Training.

Starting your program with a video tape in which department personnel are the actors and actresses helps identify the situations as actual case studies. Evaluation of positive and negative situations in the film is an ideal way to approach the second part of the first objective, i.e., understanding the need for sensitivity training.

During this segment the trainer should move into the role of facilitator rather than instructor. Research shows that participant involvement contributes towards greater interest, application and achievement. The intent here is to get everyone actively involved in the discussion either by identifying areas which need improvement or by participants relating to the group how they handled similar situations. Don't allow any one person to dominate the discussion. The cohesiveness of the unit can be strengthened by attempting to draw out the quiet individual as well as the old-timer whose body language indicates total boredom. The facilitator should ask open-ended How, What and When questions. In general, avoid asking questions that begin with Why. Sometimes Why questions make an employee feel that he or she must justify himself or herself. Listen carefully to what is being said. The responses given by you and other participants can help overcome defensiveness on the part of the employees. By offering suggestions for improvement, employees are acknowledging the fact that there is a need for training and are getting involved in the solution to the problem. Their analyses provides the justification for your training program.

Flip charts should be used to record both the incorrect behavior and suggested remedies for each situation. To be effective, the flip charts should be visible to all members of your audience at all times. Don't rush through this segment of your program. You should allow about 20 minutes for this process. When you have completed the "understanding the need for training" segment, the flip charts will, more than likely, contain most of what you want to stress when discussing the proper procedure the employee is to follow when on the job.

Appreciation Of The Need For Training.

The last part of the first objective, appreciation of the need for customer relations or sensitivity training, can be conducted with either a facilitator or an instructor.

Stress the value of running the unit as a business within a business, and that any successful business must have a set of goals. People's behavior is directed towards the attainment of goals. Therefore, it is important that your employees know the unit's goals and also have their own set of personal goals. It is equally important that employees and management realize that unprofessional behavior may mitigate the possibility of achieving personal and unit goals. At this point you could review the goals of the unit. It may be surprising to learn that some of your employees are unaware of the existance of any unit goals.

Remind your staff of several important facts which sometimes are forgotten:

1. We are paid to handle complaints or requests for service. If there are no complaints, there is no need for most of us in Facilities Management.

2. Our customers must be satisfied. If they are not satisfied, a complete service has not been rendered. In today's competitive market, there is hardly any phase of the operations function that cannot readily be taken over by a service contract. You don't want to create a threatening situation, but this is a verified fact that must be recognized. Emphasize the fact that the Facilities Management Department exists mainly to provide a service which will enable the institution to reach its goal. When we forget our primary goal and become complacent, we are in danger of being replaced by another group whose goal is to provide a better service.

3. We must sell ourselves and our department. Most customers think of us, the employees, as the Facilities Management Department. Therefore, when they perceive the Department as unprofessional, they also perceive you and me as unprofessional. Our employees can sometimes be our own worst enemies by "badmouthing" the department or the administration while on the job. Most departments have their own problems and they don't want to waste their time listening to our employee's gripes and complaints. What may have started out as a request for service, can end with a phone call or letter to the department head or vice president about an employee's inappropriate behavior.

Employ Practical Techniques and Procedures Which Will Improve Employee Sensitivity.

One of the most important statements we all can hope to get across to our employees is, treat the customer in the same manner as you would expect to be treated if a service representative provided a similar service in your home. However, you also want your employees to know that you expect reciprocal treatment from the customer toward your staff. Each member of the campus community, whether it is a student, the president or a janitor, should be treated with respect and dignity.

On-going staff development programs can strengthen department loyalty. Continual and effective training can raise the competence and confidence level of your employees. When employees know the proper procedure and know that it is standard procedure practiced throughout the department, they feel confident in responding to any work request.

Obviously, once you have identified the areas needing improvement, you will want to give your employees a set of procedures to follow when responding to a work request. In order to make your training session personalized, and show that you are listening to the comments of the participants, you should refer to the flip charts used earlier in the session. As you thoroughly discuss each step of the procedure, mention the name of the person who identified the situation and any appropriate suggestions for improvement that may apply. Again, attempt to get participant involvement. Encourage questions so that there is a clear understanding of what is expected.

You can conclude your program with the same effective technique with which it began. Instead of the video tape depicting inappropriate behavior, of course, all situations will be acted out in the manner you just discussed.

At the University of Cincinnati we have developed an eight-step procedure which our employees are to follow whenever they are responding to a work request. Everything is simple, basic and common sense, but it is important to remember that you cannot assume that all employees know the basics of proper etiquette while in another's domain.

1. Knock. Whether the door is open or closed, knock before you enter the area.

2. Identify yourself and state why you are there. Attempt to locate the person who placed the work request. Make certain that it is OK to do the work at that time. If the time is inconvenient, find out when you can return to perform the job; make certain you follow through on the commitment. If an emergency arises and the schedule must be changed, be sure you communicate this information to the department.

3. Investigate. On occasions it is evident from the minute you walk into the area that the job request is not within your jurisdiction. Don't just leave the area; check the job out, and, to the best of your ability verify the nature of the repair. Call the work control center to request a new work order be issued stating what you determined the problem to be, then notify your supervisor so he can apprise the appropriate unit supervisor of the situation.

4. Communicate. Let the person who requested the service know the status of the job. (a) If you can do the repair, approximately how long it will take. If the amount of time required to complete the job is more than you anticipated, check again to make certain that the additional time will not interrupt the department schedule. If so, reschedule the service for another time. (b) If there is a need for parts to be ordered, let the person know approximately how long delivery will take. (c) If the repair is not within your scope of responsibility, make certain the customer is told that a member of another crew will be responding to complete the job. Nothing can be worse than having a steady steam of department personnel going in and out, looking like the Three Stooges, and not letting anyone know what is going on.

Equally important as communicating with the department requesting service is the need to communicate all pertinent information to the Work Control Center. In the event other persons call about the same job, they can be advised of the reason for the delay.

5. Be enthusiastic and energetic--present a positive picture. Don't downgrade the department administration. If you are unable to complete a repair because of a systems problem, explain that to the customer. If he becomes annoyed or angry, don't argue, simply state that you will have your supervisor contact him to explain the situation. Make certain you pass this information on to your supervisor as soon as possible.

6. Clean-up. Before you leave the area, make certain you have not left behind debris from the job, packing material or old parts.

7. Check out requests for additional service. If there is an on-the-job request for additional service, check out the new work request. If the job will take more than a few minutes to complete, explain that it will be necessary for a new work order to be issued. Before you leave the area, call the work control center to initiate the paper work for any new requests.

8. We were here. If there is no one from the department who requested the work, complete and sign the WE WERE HERE form and put it in a conspicuous spot. This 4" x 3" form has an adhesive backing down the side and fits into the employee's shirt pocket. It states the reason for the call; the work performed; whether the job was completed, if not, when someone will return. It also has a place for the employee's signature and the phone number of the Work Control Center. See Appendix 1. There is something about signing your name on any document that gives that person a sense of pride and responsibility in making sure the job is done correctly.

Implement A Follow-up Procedure For Feedback On Customer Satisfaction.

After work orders have been completed, the supervisor should randomly select areas and send an evaluation form to the customer asking, How Did We Do? We use a standard 8 1/2" x 11" page. The supervisor completes the top portion with the name and department of the person requesting the service, the date the request was called into the work control center, the date the job was completed, the work order number, the trade that performed the job and a short description of what was done. Not a technical description--just enough to enable the requesting department to recognize the service. Our mail location is preprinted on the reverse side so that the department has only to complete the form, fold it in half and drop it into the campus mail. (See Appendix 2). Feedback can also come from the We Were Here Form stuck on the door or telephone if no one was at the job site. Neither of these forms are meant to replace the periodic contact you maintain with the campus community. They are only additional vehicles which will enable you to gain feedback about your service.

It is important that your employees know that you are there to support each of them. They are, of course, the most important part of a manager's job. A little sincere praise goes a long way in motivating employees. It makes them feel that they are making a contribution toward the unit's achievement of its goals and instills in them a sense of pride. Get to know your people; find out what is important to each of them. A pat on the back may be rewarding for one, but meaningless to another.

Everyone wants to be recognized as competent and capable. When you receive favorable responses be sure to let your employees know that you do appreciate the effort. Take the time to tell them what they did right. Recognition helps morale, good morale increases production and production gets the job done--and that, in essence, is what Facilities Management is all about. Keep these responses in your critical incident file for referral when preparing an employee's performance review.

When a negative response is received, address the problem immediately, but calmly. Listen actively and avoid interrupting while the employee is giving you an account of the situation. By allowing the person to talk, you are reducing his or her defensiveness. Assure that person that you are there to find out what went wrong and to offer a solution so that the misunderstanding can be avoided in the future. This is not to say that the employee was in error. No matter what went wrong, if you receive a negative response, it indicates that there is probably a communication problem. If a reprimand is required, end the session by reminding the employee of how good he or she is as a person. You don't want the employee confusing inappropriate behavior with self worth. Establish a we approach, convey a positive attitude and it is bound to be contagious.

Since you requested the customer's opinion of your service, follow up any negative responses with some means of acknowledgement. More than likely a simple phone call will suffice. If the situation warrants, stop into the department office. Thank the customer for responding to the form and for giving you the opportunity to improve your service level.

When you have a well-planned, organized, controlled and evaluated operation, you will also have highly motivated workers who are proud to be a part of your team.

In summary, I've discussed recognizing the real problem and the need for improvement, identified some specific situations, recommended simple procedures to help eliminate the problems, used feedback from the customer as a means of two-way communication, and suggested techniques to increase employees' pride and job satisfaction. This covers all points stated in the program description. Hopefully, it may be a useful tool in helping your tradesmen respond professionally whenever they are acting as agents of your Facilities Management Department.

Appendix I

WE WERE HERE

FACILITIES MANAGEMENT

You Called Because: ____________________

____

____

____

____

Work Performed: ____________________

____

____

Complete? Yes ☐ No ☐

Will Return ____________________

Signed ____________________ Phone 475-4733

Appendix II

DEPARTMENT OF FACILITIES MANAGEMENT

HOW DID WE DO?

To: ______________________________ Dept. ________________________

Work Order Number ________________ Trade ________________________

Date Requested ____________ Date Completed ________________________

Work Performed

1. Was our response time to your work request acceptable? Yes____, No____. If no, why not?

2. Once started, was the work done promptly? Yes___, No___. If no, in your opinion what was wrong?

Upon completion, was the area cleaned up properly? Yes___, No___.

3. If it was necessary for the job to be delayed, was this communicated to you? Yes___, No___

4. Were the workers pleasant? ________________________________

5. Was the work done professionally? If not, what, in your opinion, was unprofessional?

6. When you have a Facilities Management related problem, do you call Work Control____, the foreman____, a supervisor or manager___, or other ______________________(specify)

7. What is your overall perception (or other comments) of the Department of Facilities Management.

8. Do you think communication between Facilities Management and the campus community is good____, fair____, poor____? How do you think it could be improved?

9. Would you like a representative from Facilities Management to ____call you, ____visit with you to answer questions?

Signed: ______________________________ Phone number __________

THANK YOU FOR HELPING FACILITIES MANAGEMENT SERVE YOU BETTER.

Our mail location is preprinted on the reverse side....simply fold in half and drop into the campus mail.

Supervisor______________________________________Phone________

Physical Facilities Evaluation

Henry L. Shelby
Director, Campus Development and
Facilities Planning
Tennessee Technological University

The design of this presentation is to describe the procedure used by Tennessee Technological University in determining accurate and comparable information on the physical and functional condition of existing facilities for future planning purposes. This survey is completed at four years intervals and had its beginning in 1976. During this presentation, comparative ratings will be shown so that each of you can see the effects that the program has had on the updating of the facilities.

This Facilities Evaluation format was designed so that the condition of each facility can be rated by utilizing detailed rating forms. This procedure can be used for any number of buildings and is an effective method of informing those who provide funding with the details needed to make sound judgments based on the total rather than portraying a partial picture. If the same individual or team is used to survey all buildings, consistency will prevail, and each building value will be relative to the value of all other buildings. The purpose is best served if the persons making the survey are professionals experienced in facilities planning and construction. In our opinion the best analysis comes about by having campus representatives make a survey and then having an independent survey made by others. For funding purposes it is far more effective when the survey is made by those who are trusted most by those who are responsible for appropriating the funds.

All institutionally-owned facilities should be surveyed even though the source of funding might come from numerous sources. This will allow total comparisons as well as groupings according to funding sources such as state appropriations, auxiliary enterprises, or local funding. In making the functional analysis of a facility, the evaluation should be limited to the individual structure in its present programmatic usage. The survey should not address the relationship of a structure to future programmatic needs of a campus. There is no reason to survey facilities that are under construction or major renovation.

Forms have been developed so that detailed information can be recorded according to five major divisions: Primary structure, secondary structure, service systems, functional standards, and safety standards. A summary sheet is used for listing the total picture comparing the actual values with the maximum values for each increment. Each sheet of the survey forms requires a rating of system types, system evaluation, comments, and numerical evaluation.

Some of the data is actual while other data is judgmental. This procedure forces a composite of all of the information concerning each facility to be compiled so that an accurate appraisal can be made. This completed document will be used over and over for reference thus eliminating the need in many cases to review drawings and specifications for answers that might be needed.

On each evaluation sheet, the Condition Value Multiplier is based on a constant scale of 0.0 to 1.0 points based upon the ease or difficulty and cost of correcting the component factor. Prior to obtaining a final building rating, consideration should be given to the functional analysis of the facility. For example, in the physical evaluation, a building may be classified in the (U) demolition category; however, for historical or aesthetic reasons, the University may want to remodel the facility. On the other hand, a facility may fall in a remodel category, but the University may want to demolish the facility because the building conflicts with the campus plan for land use.

A completed set of forms showing the actual ratings of Kittrell Hall in March of 1984 is shown.

After forms for each building have been completed, it will be interesting to compile the information in a manner that will allow rapid comparison by building usage or funding sources. Included in this report are two such comparisons; one for academic and service buildings in which major maintenance funds are appropriated by the State Capital Outlay formula and another for dormitories which as auxiliary enterprises must be funded through student fees. Local funds are often used for remodeling and/or renovation of academic buildings when the total cost is less than $50,000.

This system also allows for groupings according to individual criteria which might be the most efficient method for correcting potential problems in several different buildings. Such a grouping is included in this report that was completed in 1984. You will note that only one building was listed below the maximum value for problems with the foundation system in academic and service buildings while eight had problems with column and exterior walls and two with floor system problems.

The final item included is data comparing the actual ratings for 1976, 1980, and 1984 for each building.

Form B
CB50-PFES384

PHYSICAL FACILITIES EVALUATION SUMMARY

Building Number & Name KH Kittrell Hall

Location Tennessee Technological University

Survey Date March 1984

Survey Team For University:
James Sherrell
Henry L. Shelby

For State of Tennessee:
Richard Schellhardt
Clayton Dekle
Mike Fitts

	Ratings Possible	Ratings Actual
I. Primary Structure	(40)	(33.2)
1. Foundation System	13	13
2. Column & Exterior Wall System	13	10.4
3. Floor System	7	7
4. Roof System	7	2.8
II. Secondary Structure	(9)	(4.9)
1. Ceiling System	3	1.5
2. Interior Walls & Partitions	3	3
3. Window System	2	.4
4. Door System	1	0
III. Service Systems	(34)	(34)
1. Cooling	10	10
2. Heating	10	10
3. Plumbing	5	5
4. Electrical	8	8
5. Conveying	1	1
IV. Functional Standards	(12)	(12)
1. Assignable Space	4	4
2. Adaptability	4	4
3. Suitability	4	4
V. Safety Standards	(5)	(2.5) ~~2.5~~ 3.5
TOTAL	100	~~86.6~~ 87.6

BUILDING RATING*

S. Satisfactory	95 - 100	
2. Remodeling - A	75 - 94	X
3. Remodeling - B	55 - 74	
4. Remodeling - C	35 - 54	
U. Demolition	0 - 34	

*Transfer rating to Form B. VII

KITTRELL HALL Building

Form B

Form B. I - 1

I. 1. Primary Structure - Foundation

A. System type

(1) Exterior columns: individual ftgs. & piers x predrilled piling ___ driven piling ___
continuous ftgs. x caissons ___ mats ___

(2) Foundation materials: steel x concrete x wood ___ other ___ combination x

(3) Interior footings: individual ftgs & piers x piling, pile caps & piers x

(4) Foundation walls: continuous ftgs. x grade beams ___

B. System Evaluation

	S	2	3	4	U	Comments
(1) Cracked walls	x					
(2) Foundation settlement	x					
(3) Foundation deterioration	x					
(4) Design load	x					

C. Comments: ALL ITEMS ARE IN EXCELLENT CONDITION.

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 13 x 1 (Condition Value Multiplier) = 13

I. 1. Primary Structure - Foundation KITTRELL HALL Building

Form B. I - 1

Form B.1-2

1.2. Primary Structure - Column & Exterior Wall System

A. System type

(1) Structural - reinforced concrete columns x Structural steel ___

reinforced concrete walls x Structural wood ___

load bearing masonry x light steel frame ___

(2) Non-Structural Walls:

Masonry: brick x concrete block x limestone ___ marble ___ granite ___ other ___

Curtain or panel: metal ___ glass ___ asbestos cement ___ laminated ___ other ___

(3) Insulation: fiberglass bats ___ other ___ thickness ___

B. System Evaluation

	S	2	3	4	U	Comments
(1) Physical condition	x					
(2) Waterproofing		x				
(3) Caulking			x			
(4) Cleaning, pointing		x				
(5) Code compliance	x					
(6) Insulation					x	NO INSULATION IN WALL
(7) Maintainability	x					
(8) Painting		x				

C. Comments: A PROJECT SHOULD BE DEVELOPED TO TUCK-POINT AND CLEAN THE EXTERIOR OF THE BUILDING. MOST OF THE INTERIOR OF THE BUILDING NEEDS TO BE PAINTED.

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
(S) Satisfactory	1.0
[✓ (2)] Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 13 x .8 (Condition Value Multiplier) = 10.4

1.2. Primary Structure - Column & Exterior Wall System KITTRELL HALL Building

Form B.1-2

Form B.1-3

I. 3. Primary Structure - Floor System

A. System type

Classification: 1 hr.__X__ 2 hr.____ 4 hr.____ other____

Structure:

(1) Reinforced concrete: slab & beam__X__ pan joist____ two-way slab____ waffle slab____

flat slab__X__

Precast concrete: double tee____ span deck____ single tee____

Structural steel: bar joist__X__ metal deck__X__ steel frame____ wood frame____

(2) Floor finish: VAT__X__ concrete__X__ wood____ carpet____ terrazo____ brick____

quarry tile____ ceramic tile____ epoxy____ other____

B. System Evaluation

	S	2	3	4	U	Comments
(1) Structural condition	X					
(2) Maintainability	X					
(3) Floor finish	X					
(4) Vibration	X					
(5) Fire rating	X					
(6) Design load	X					

C. Comments: ALL FLOOR TILE IS IN EXCELLENT CONDITION.

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 7 x __1__ (Condition Value Multiplier) = __7__

I. 3. Primary Structure - Floor System KITTRELL HALL Building

Form B.1-3

I. 4. Primary Structure - Roof System

Built-Up	1,325 sq. ft.
Pitched	7,000 sq. ft.
Total	8,325 sq. ft.

A. System types

(1) Flat

(a) Concrete: slab & beam___ flat slab___ joist & slab___ waffle slab___ two-way slab___ other X

(b) Precast concrete: double tee___ single tee___ span deck___

(c) Steel: metal deck & beam___ metal deck & joists___ tectum & joist___

(2) Pitched

(a) Steel: truss & wood deck___ truss & nailable concrete___ other___

(b) Wood rafters & sheathing X wood truss & sheathing___ other___

(3) Insulation: light weight concrete___ rigid fiberglass___ vermiculite w/asphalt binder___ urethane___ polystyrene___ fesco board___ foam glass___ fiberglass (bats)___ other___

(4) Roof material: built up asphalt___ built up coal tar pitch X asphalt shingles___ clay tile___ asbestos shingles___ slate X copper___ steel___ aluminum___ other___

(5) Parapets: concrete X brick X block___ precast concrete___ other___

B. System Evaluation

	S	2	3	4	U	Comments
(1) Physical condition			X			
(2) Leaks			X			
(3) Drainage		X				
(4) Insulation					X	NO INSULATION IN ROOF SYSTEM
(5) Dissimilar types			X			
(6) Fire rating			X			
(7) Design Load	X					

C. Comments: THE ROOFING MATERIAL NEEDS TO BE REPLACED IN ITS ENTIRETY AS SOON AS POSSIBLE. INSULATION SHOULD BE ADDED WHEN THIS IS DONE.

D. Numerical Evaluation (circle one)	Condition Value Multiplier
(S) Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
[✓ (3)] Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 7 x .4 (Condition Value Multiplier) = 2.8

I. 4. Primary Structure - Roof System KITTRELL HALL Building

BEST COPY AVAILABLE

II. 1. Secondary Structure - Ceiling System

A. System type

(1) Integral systems: exposed structure___ attached to structure x

(2) Suspended system: lay-in metal grid___ concealed spline metal grid___ gypsum board___ plaster x other___

(3) Materials: mineral___ wood fiber x fiberglass___ metal___ wood___ other___

(4) Finishes: integral___ paint x fabric___ other___

B. System Evaluation

	S	2	3	4	U	Comments
(1) Physical condition					x	
(2) Suitability					x	
(3) Accessibility					x	
(4) Appearance					x	
(5) Code compliance					x	

C. Comments: THE WOOD FIBER CEILING MATERIAL IS ATTACHED TO WOODEN LATHE. THIS SHOULD BE REPLACED AS SOON AS POSSIBLE.

D. Numerical Evaluation (circle one)	Condition Value Multiplier
(S) Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
[✓ (3)] Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 3 x .5 (Condition Value Multiplier) = 1.5

II. 1. Secondary Structure - Ceiling System KITTRELL HALL Building

Form B. II - 2

II. 2. Secondary Structure - Interior Walls & Partitions

A. System type

(1) Classification: Moveable___ rigid x load bearing x

(2) Framing: metal stud___ wood stud___ masonry X other___

(3) Material: plaster x drywall___ wood paneling___ exposed masonry x ceramic tile___ concrete___ structural glazed tile___ other___

(4) Finish: integral___ painted x vinyl wall covering___ other___

B. System Evaluation

	S	2	3	4	U	Comments
(1) Strength & stability	x					
(2) Appearance	x					
(3) Physical condition	x					
(4) Acoustical quality	x					
(5) Adaptability	x					
(6) Maintainability	x					
(7) Code compliance	x					

C. Comments: THE WALLS ARE IN EXCELLENT CONDITION.

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 3 x 1 (Condition Value Multiplier) = 3

II. 2. Secondary Structure - Interior Walls & Partitions KITTRELL HALL Building

Form B. II - 2

Form B . II - 3

II. 3. Secondary Structure - Window System

A. System type

(1) wood x steel___ aluminum___

(2) double hinge___ fixed glass___ casement___ projected___ awning___ reversible___

(3) single glazing x double glazing___ clear glass x heat absorbing glass___ tinted glass___ other___

(4) Shading devices: interior blinds x exterior blinds___ solar screens___ awning___ shades x drapes x architectural devices___ other___

B. System Evaluation

	S	2	3	4	U	Comments
(1) Functional ability				x		
(2) Physical condition					x	
(3) Appearance					x	
(4) Infiltration				x		
(5) Maintainability				x		

C. Comments: THIS BUILDING HAS DOUBLE HUNG WINDOWS THAT WERE INSTALLED IN 1916. THE TYPE WINDOW DOES NOT BLEND WITH OTHER BUILDING WINDOWS ON CAMPUS. THERE IS AN EXTREME LOSS OF HEATING AND COOLING THROUGH THE LOOSE FITTING WINDOWS. THESE SHOULD BE REPLACED AS SOON AS POSSIBLE.

D. Numerical Evaluation (circle one)	Condition Value Multiplier
(S) Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
[✓ (4)] Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 2 x .2 (Condition Value Multiplier)= .4

II. 3. Secondary Structure - Window System KITTRELL HALL Building

Form B . II - 3

Form B. II - 4

II. 4. Secondary Structure - Door System

A. System types:

aluminum____ steel____ wood X all glass____ sliding____ hinged X folding____

B. System Evaluation

	S	2	3	4	U	Comments
(1) Door leaf					X	
(2) Frame				X		
(3) Hardware					X	
(4) Closers					X	
(5) Security					X	
(6) Panic devices					X	
(7) Fire rating					X	
(8) Keying					X	

C. Comments: DOORS ARE PANELED. DO NOT MEET FIRE CODE. HARDWARE NEEDS REPLACING. NEW LOCKS NEED TO BE INSTALLED AND NEW KEYING SYSTEM CODED WITH CAMPUS MASTER PLAN. NEW CLOSERS NEED TO BE INSTALLED ON ALL DOORS. DOOR FRAMES ARE IN FAIR CONDITION BUT SOME NEED REPAIRING.

D. Numerical Evaluation (circle one)	Condition Value Multiplier
(S) Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
[✓ (U)] Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 1 x 0 (Condition Value Multiplier) = 0

II. 4 Secondary Structure - Door System KITTRELL HALL Building

Form B. II - 4

Form B. III -1

III. 1. Service Systems - Cooling System

A. System types

(1) Space Equipment:

Direct Expansion - Window units ___ Thru-the-wall ___ Single zone___

All-air miltizone ___ Single zone con.vol.___ Double duct___

Air - Water - 2-pipe fan coil ___ Unit ventilators ___ Induction ___

4-pipe fan coil x Terminal reheat ___

Variable volume ___ Var.vol. reheat ___

(2) Refrigeration type & quantity - recip. dx___ water chiller-recip.___ cent. x abs.___

(3) Energy source - central plant x electricity___ steam___ gas/oil___

(4) Heat rejection device - air condenser___ wood tower___ metal tower___

(5) System capacity - Total 1300 tons - CENTRAL SYSTEM

(6) Control type - elect.___ pneu. x

B. System Evaluation	S	2	3	4	U	Comments
(1) Cooling capacity	x					
(2) Temperature controls	x					
(3) Cooling all season	x					
(4) Noise level	x					
(5) Energy consumption reasonable	x					
(6) Air circulation & ventilation	x					
(7) Reliability	x					
(8) Economizer cycle installed						
(9) Filtration	x					
(10) Humidity	x					

C. Comments: CENTRAL CHILLER INSTALLED IN 1971 AND THIS BUILDING WAS ADDED TO THE SYSTEM AT THE SAME TIME.

D. Numerical Evaluation (circle one)	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 10 x 1 (Condition Value Multiplier) = 10

III. 1. Service Systems - Cooling System KITTRELL HALL Building

Form B. III -1

Form B. III - 2

III.2. Service Systems - Heating System

A. System types

(1) Transfer medium - steam ___ hot water X air ___ elect. ___

(2) Space equipment

Radiators		2-pipe fan coil		Multizone	
Convectors		4-pipe fan coil	X	Double duct	
Finned Tube		Unit ventilators		Terminal reheat	
Baseboard		Radiant		Con. vol. single zone	

(3) Energy Source: central plant X coal ___ gas ___ oil ___ elect. ___

(4) System Capacity - Total ________ BTUH   Control Type - pneu. X elect. ___

B. System Evaluation

	S	2	3	4	U	Comments
(1) Heating capacity	X					
(2) Temperature control	X					
(3) Heating all seasons	X					
(4) Noise level	X					
(5) Energy consumption	X					
(6) Air circulation & ventilation	X					
(7) Filtration	X					
(8) Humidity control						

C. Comments: THE SYSTEM WAS REPLACED IN 1971 AND REMAINS IN EXCELLENT CONDITION.

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 10 x 1 (Condition Value Multiplier) = 10

III.2. Service Systems - Heating System   KITTRELL HALL Building

Form B.III - 2

Form B. III - 3

III. 3. Service Systems - Plumbing System

A. System types

(1) Services available:

cold water	X	acid waste		oxygen		sprinkler	
hot water	X	natural gas	X	nitrogen		standpipe	
sanitary drain	X	vacuum		deionized water			
storm drains	X	compressed air	X	distilled water			

(2) Water heating system:

(a) Energy source ELECT. (c) Recovery capacity ______ gph

(b) Storage capacity 42 gal.

B. System Evaluation

	S	2	3	4	U	Comments
(1) Supply quantities	X					
(2) Drain & waste function	X					
(3) Sanitation hazards or cross-connections	X					
(4) Fixture quantities	X					
(5) Fixture types & conditions	X					
(6) Wheelchair fixtures	X					
(7) Female facilities	X					
(8) Roof drainage	X					
(9) Site drainage	X					

C. Comments: THE SYSTEM IS IN EXCELLENT CONDITION. HANDICAP FIXTURES HAVE BEEN INSTALLED DURING THE LAST FIVE YEARS.

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 5 x 1 (Condition Value Multiplier) = 5

III. 3. Service Systems - Plumbing System KITTRELL HALL Building

Form B. III - 3

Form B. III - 4

III.4. Service Systems - Electrical System

A. System types

(1) Power System

Service voltage 110-208 3 PHASE Amperage 400

Dist. voltage 110-208 Watts/sq.ft. ____

(2) Lighting System

Basic lamp type - incand.____ fluor. X HID____ other____

Basic fixture type - Fluor. lamp

B. System Evaluation

	S	2	3	4	U	Comments
(1) Power System						
(a) Safety conditions	X					
(b) Service capacity	X					
(c) Switchgear capacity	X					
(d) Feeder capacity	X					
(e) Panel capacity	X					
(f) Convenience outlets	X					
(2) Lighting System						
(a) Light levels	X					
(b) Fixtures	X					
(c) Emergency lighting					X	NONE
(d) Exit lighting	X					

C. Comments: IT HAS BEEN DETERMINED THAT EMERGENCY LIGHTING IS NOT NEEDED.

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 8 x 1 (Condition Value Multiplier) = 8

III.4. Service Systems - Electrical System
Form B. III - 4

KITTRELL HALL Building

Form B. III - 5

III. 5. Service Systems - Conveying

A. System types

(1) Conveying Systems and quantity of each:

(a) Elevators: electric gearless___ electric gear___ hydraulic___

(b) Dumbwaiters___ lifts___ escalators___ pneu.tube___

(2) Elevator speed: electric 1___ fpm hydraulic 2___ fpm

(3) Elevator capacity: electric 1___ lb. hydraulic 2___ lb.

(4) Elevator control type: manual___ selective___ selective collective___ group supervisory___

B. System Evaluation:

Elevators & Escalators	S	2	3	4	U	Comments
(1) Speed						
(2) Size						
(3) Condition						
(4) Appearance						
(5) Maintainability						
(6) Noise						
(7) Code compliance						
(8) Pneumatic tubes						
(9) Dumbwaiter						

C. Comments: THERE ARE NO ELEVATORS OR ESCALATORS IN THIS BUILDING AND NONE ARE NEEDED. PROVISIONS FOR HANDICAPPED STUDENTS ARE PROVIDED ON THE GROUND LEVEL FLOOR.

D. Numerical Evaluation (circle one)	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 1 x 1 (Condition Value Multiplier) = 1

III. 4. Service Systems - Conveying KITTRELL HALL Building

Form B. III - 5

Form B. IV - 1

IV. 1. Functional Standards - Assignable Space

A. Space Inventory

(1) Total floor space (gross area) = 18,473 sq. ft.

(2) Assignable space (net area) = 12,465 sq. ft.

(3) Assignable space ratio $\frac{(2)}{(1)}$ = 67.5 %

B. Evaluation

	S	2	3	4	U	Comments
Assignable space ratio is	x					

C. Comments: SINCE THE BUILDING WAS ORIGINALLY CONSTRUCTED AS A DORMITORY, THE ASSIGNABLE SPACE RATIO TO GROSS AREA IS LOW BUT THERE IS NO EASY SOLUTION

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
[✓ (S)] Optimum for facility of this type	1.0
(2) Adequate for facility of this type	0.8 ± .1
(3) Fair for facility of this type	0.5 ± .1
(4) Poor for facility of this type	0.2 ∓ .1
(5) Bad for facility of this type	0.0

THEC approved standards

	Net	Gross
Physical Education Facilities	70	30
Libraries	80	20
General Academic Buildings	60	40

E. Numerical Rating: 4 x 1 (Condition Value Multiplier) = 4

IV.1. Functional Standards - Assignable Space KITTRELL HALL Building

Form B. IV - 1

IV. 2. Functional Standards - Adaptability

A. System Evaluation

	S	2	3	4	U	Comments
(1) Flexible design concept	X					
(2) Partitions (moveable or rigid)	X					
(3) Specialized building type	X					
(4) Flexible service systems	X					
(5) Stationary equipment	X					

B. Comments: THE NEEDS OF THE DEPARTMENT OF GEOLOGY ARE MET.

C. Numerical Evaluation

	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

D. Numerical Rating: 4 x 1 (Condition Value Multiplier) = 4

IV. 2. Functional Standards - Adaptability KITTRELL HALL Building

Form B. IV - 2

Form B. IV - 3

IV. 3. Functional Standards - Suitability

A. System Evaluation

	S	2	3	4	U	Comments
(1) Educational spaces						
(2) Working environment	x					
(3) Circulation & functional relationships	x					
(4) Conflicting uses	x					
(5) Other	x					

B. Comments: VERY SUITABLE FOR THE DEPARTMENT OF GEOLOGY.

D. Numerical Evaluation (circle one)

	Condition Value Multiplier
[✓ (S)] Satisfactory	1.0
(2) Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

E. Numerical Rating: 4 x 1 (Condition Value Multiplier) = 4

IV.3. Functional Standards - Suitability KITTRELL HALL Building

Form B. IV - 3

Form B. V

V. Safety Standards

A. System types

(1) Exits:

(a) Stair construction: concrete X steel ___ wood ___

(b) Stair enclosures: none X 1 hour ___ 2 hour

(c) Travel distance 50 ft.

(d) Number of exits 3

(2) Fire ratings:

(a) Construction type: I ___ II ___ III X IV ___ V ___ VI ___

(b) Building height 37 ft., 3 stories

(c) Building occupancy group: A-Residental ___ B-Business ___ C-School X D-Institutional ___ E-Assembly ___ F-Storage ___ G-Industrial ___ H-Hazardous ___

(3) Extinguishing systems: portable extinguishers X standpipe ___ hose cabinets ___ sprinklers ___ other ___

(4) Detection and alarm systems: manual alarm X w/annunciator ___ smoke detectors ___ fire detectors ___ visual ___ audible X

(5) Lighting systems: exit signs ___ exit lighting X emergency power batteries ___ emergency generator ___ other power ___

B. System Evaluation

	S	2	3	4	U	Comments
(1) Means of egress				X		NONE FROM BOTTOM LEVEL
(2) Fire ratings			X			OPEN STAIRWELLS
(3) Extinguishing systems	X					
(4) Detection & alarm systems	X					
(5) Lighting system	X					
(6) Handicap accessibility	X					

C. Numerical Evaluation

	Condition Value Multiplier
(S) Satisfactory	1.0
[✓ (2)] Remodeling A - Requires restoration, cost not more than 25% of total replacement	0.8 ± .1
(3) Remodeling B - Requires major modernization, cost between 25 and 50% of total replacement	0.5 ± .1
(4) Remodeling C - Requires major remodeling, cost greater than 50% of total replacement	0.2 ± .1
(U) Demolition - System is totally unsatisfactory and cannot be remodeled - replace	0.0

D. Numerical Rating: 5 x .5 (Condition Value Multiplier) = 2.5

V. Safety Standards
Form B. V

KITTRELL HALL Building

Form B. VI - 1

VI.1. Functionality Analysis (Negative)

A. Considerations:

(1) Future land use: conflicting land use with campus plan.
(2) Suitability: spatial characteristics relative to specific use.
(3) Aesthetics: visual qualities and physical arrangement with other buildings.
(4) Social and community values: conflicts and attitudes detrimental to campus and community.
(5) Intangible values: orientation, phychological environment, noise, odors, etc.

B. Comments: N/A

*C. Rating (check one)

(S) Satisfactory X
(2) Remodel A ___
(3) Remodel B ___
(4) Remodel C ___
(U) Unsatisfactory ___

*transfer rating to Form B.VII

VI.1 Functionality Analysis (Negative) KITTRELL HALL Building

Form B. VI - 1

Form B. VI - 2

VI. 2. Functionality Analysis (Positive)

A. Considerations:

(1) Traditional value: significant role or meaning relative to institutional customs, habits, or traditional practices or values.

(2) Historical value: significant role or meaning relative to the history of the institution.

[✓ (3)] Aesthetic value: outstanding visual qualities and physical arrangement with other buildings.

(4) Social and community values:

(5) Intangible values: facility could be used temporarily for other functions or activities or is suitable for highly specialized usage that is difficult to replace.

B. Comments: NONE

*C. Rating (check one)

[✓ (S)] Satisfactory x
(2) Remodel A ____
(3) Remodel B ____
(4) Remodel C ____
(U) Unsatisfactory ____

*transfer rating to Form B.VII

VI.2. Functionality Analysis (Positive) KITTRELL HALL Building

Form B. VI - 2

VII. Rating Summary

A. General Information

Date MARCH, 1984

(1) Building No. KH

(2) Building Use ACADEMIC

(3) Building Name KITTRELL HALL

(4) Year Occupied 1916 - Addition 1954

(5) Gross Square Feet 18,473

(6) Assignable Square Feet 12,465

B. Numerical Rating

	S	2	3	4	U	Comments
(1) Physical analysis		x				
(2) Functionality analysis (neg.)	x					
(3) Functionality analysis (pos.)	x					
(4) Final recommended rating	x					

C. Comments: THIS BUILDING BLENDS IN WITH OTHER BUILDINGS ON CAMPUS AND HOUSES THE DEPARTMENT OF GEOLOGY ADEQUATELY.

D. Campus Rating

Date March, 1984

Rating 86.6

E. Survey Team Rating

Date March, 1984

Rating 87.6

PHYSICAL FACILITIES EVALUATION SUMMARY — ACEDEMIC & SERVICE BUILDINGS — 1984

EVALUATION CRITERIA	MAXIMUM POSSIBLE RATING	ACTUAL RATING LISTED BY BUILDING CODE																
		BH	BN	BR	CH	DH	DN	EC	ES	FA	FB	FH	FN	HH	HP	JH	KH	LA
I. PRIMARY STRUCTURE																		
1. FOUNDATION SYSTEM	13	13	13	13	13	13	13	13	13	13	13	13	13	13	11.7	13	13	13
2. COLUMN & EXTERIOR WALL SYSTEM	13	13	13	9	13	13	13	13	11.7	13	13	13	13	13	11.7	10.4	10.4	13
3. FLOOR SYSTEM	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
4. ROOF SYSTEM	7	7	3.5	4.9	4.2	7	7	6.3	7	7	7	7	7	7	7	5.6	2.8	7
SUB TOTAL	40	40	36.5	33.9	37.2	40	40	39.3	38.7	40	40	40	40	40	37.4	36	33.2	40
II. SECONDARY STRUCTURE																		
1. CEILING SYSTEM	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1.5	3	1.5	3
2. INTERIOR WALLS & PARTITIONS	3	3	3	3	3	3	3	3	3	3	3	3	3	1.5	2.4	3	3	3
3. WINDOW SYSTEM	2	2	2	2	2	2	2	1.8	2	2	2	2	2	2	2	2	.4	1
4. DOOR SYSTEM	1	.2	1	1	1	1	1	1	1	1	.2	.5	1	.2	.8	1	0	.2
SUB TOTAL	9	8.2	9	9	9	9	9	8.8	9	9	8.2	8.5	9	6.7	6.7	9	4.9	7.2
III. SERVICE SYSTEMS																		
1. COOLING	10	10	8	8	8	7	10	10	9	9	8	8	10	8	10	8	10	10
2. HEATING	10	10	8	8	8	9	10	10	9	9	8	8	10	8	10	8	10	10
3. PLUMBING	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
4. ELECTRICAL	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
5. CONVEYING	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SUB TOTAL	34	34	30	30	30	30	34	34	32	32	30	30	34	30	34	30	34	34
IV. FUNCTIONAL STANDARDS																		
1. ASSIGNABLE SPACE	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3.6
2. ADAPTABILITY	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3.2
3. SUITABILITY	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3.2
SUB TOTAL	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	10
V. SAFETY STANDARDS	5	3.5	5	5	5	4	5	5	4.5	5	3.5	4	5	3.5	5	4	2.5	4.5
SUB TOTAL	5	3.5	5	5	5	4	5	5	4.5	5	3.5	4	5	3.5	5	4	2.5	4.5
TOTAL	100	97.7	92.5	89.9	93.2	95	100	99.1	96.2	98	93.7	94.5	100	92.2	95.1	91	86.6	95.7

BUILDING RATING: 95 - 100 = (S)SATISFACTORY 75 - 94 = (2)REMODEL A 55 - 74 = (3)REMODEL B 35 - 54 = (4)REMODEL C 0 - 34 = (U)UNSATISFACTORY

PHYSICAL FACILITIES EVALUATION SUMMARY — ACADEMIC & SERVICE BUILDINGS — 1984

EVALUATION CRITERIA	MAXIMUM POSSIBLE RATING	ACTUAL RATING LISTED BY BUILDING CODE																
		LB	LH	MH	NS	OM	PH	PR	UC	US	WS	15	30	176	177	178	179	180
I. PRIMARY STRUCTURE																		
1. FOUNDATION SYSTEM	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
2. COLUMN & EXTERIOR WALL SYSTEM	13	11.7	13	13	13	13	13	13	13	13	11.7	10.4	13	13	13	13	12.7	13
3. FLOOR SYSTEM	7	7	7	7	7	6.3	7	7	7	5.6	7	7	7	7	7	7	7	7
4. ROOF SYSTEM	7	7	7	7	3.5	7	5.6	7	7	7	7	7	7	7	7	3.5	7	7
SUB TOTAL	40	38.7	40	40	36.5	39.3	38.6	40	40	38.6	38.7	37.4	40	40	40	36.5	39.7	40
II. SECONDARY STRUCTURE																		
1. CEILING SYSTEM	3	2.1	3	3	1.5	3	3	3	3	1.5	2.4	3	3	3	3	3	3	3
2. INTERIOR WALLS & PARTITIONS	3	3	3	3	2.4	1.5	3	3	3	2.4	3	3	3	3	3	3	3	3
3. WINDOW SYSTEM	2	2	2	2	1	1.2	2	2	2	.4	2	2	2	2	2	2	2	2
4. DOOR SYSTEM	1	.8	.5	1	.5	.7	1	1	1	.5	1	1	1	1	1	1	1	1
SUB TOTAL	9	7.9	8.5	9	5.4	6.4	9	9	9	4.8	8.4	9	9	9	9	9	9	9
III. SERVICE SYSTEMS																		
1. COOLING	10	10	10	10	10	10	10	10	10	7.0	10	10	10	10	10	10	10	10
2. HEATING	10	10	10	10	10	10	10	10	10	8	10	10	10	10	10	10	10	10
3. PLUMBING	5	5	5	5	5	5	5	5	5	4.5	5	5	5	5	5	5	5	5
4. ELECTRICAL	8	8	8	8	8	8	8	7.2	8	7.2	8	8	8	8	8	8	8	8
5. CONVEYING	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SUB TOTAL	34	34	34	34	34	34	34	33.2	34	27.7	34	34	34	34	34	34	34	34
IV. FUNCTIONAL STANDARDS																		
1. ASSIGNABLE SPACE	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2. ADAPTABILITY	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3. SUITABILITY	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
SUB TOTAL	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
V. SAFETY STANDARDS	5	5	5	5	4	5	5	5	5	4	5	5	5	5	5	5	5	5
SUB TOTAL	5	5	5	5	4	5	5	5	5	4	5	5	5	5	5	5	5	5
TOTAL	100	97.6	99.5	100	91.9	96.7	98.6	99.2	100	87.1	98.1	97.4	100	100	100	96.5	99.7	100

BUILDING RATING: 95 - 100 = (S)SATISFACTORY 75 - 94 = (2)REMODEL A 55 - 74 = (3)REMODEL B 35 - 54 = (4)REMODEL C 0 - 34 = (U)UNSATISFACTORY

PHYSICAL FACILITIES EVALUATION SUMMARY — DORMITORIES

EVALUATION CRITERIA		MAXIMUM POSSIBLE RATING	ACTUAL RATING LISTED BY BUILDING CODE												
			6 WE	7 AU	8 QU	9 JA	10 MD	11 MR	12 CR	20 SM	22 RY	23 DI	24 EA	25 ME	26 MA
I. PRIMARY STRUCTURE															
1. FOUNDATION SYSTEM		13	13	13	13	13	13	13	13	13	13	13	13	13	13
2. COLUMN & EXTERIOR WALL SYSTEM		13	13	13	13	13	13	13	13	13	13	13	13	13	13
3. FLOOR SYSTEM		7	7	7	7	7	7	7	7	7	7	7	7	7	7
4. ROOF SYSTEM		7	7	7	6.3	6.3	6.3	6.3	7	5.6	7	7	7	7	7
	SUB TOTAL	40	40	40	39.3	39.3	39.3	39.3	40	38.6	40	40	40	40	40
II. SECONDARY STRUCTURE															
1. CEILING SYSTEM		3	3	3	2.7	.3	3	2.1	3	1.5	3	3	3	3	3
2. INTERIOR WALLS & PARTITIONS		3	3	3	2.4	2.4	3	2.4	3	3	3	3	3	3	3
3. WINDOW SYSTEM		2	2	2	1.6	1.6	2	1.6	2	2	2	2	2	2	2
4. DOOR SYSTEM		1	1	1	.5	.5	1	.5	1	1	1	1	1	1	1
	SUB TOTAL	9	9	9	7.2	4.8	9	6.6	9	7.5	9	9	9	9	9
III. SERVICE SYSTEMS															
1. COOLING		10	10	10	10	10	10	10	10	8	10	10	10	10	10
2. HEATING		10	10	10	10	10	10	10	10	8	10	10	10	10	10
3. PLUMBING		5	5	5	5	4	5	5	5	5	5	5	5	5	5
4. ELECTRICAL		8	8	8	8	8	8	8	8	8	8	8	8	8	8
5. CONVEYING		1	1	1	1	1	1	1	1	1	1	1	1	1	1
	SUB TOTAL	34	34	34	34	33	34	34	34	30	34	34	34	34	34
IV. FUNCTIONAL STANDARDS															
1. ASSIGNABLE SPACE		4	4	4	4	4	4	4	4	4	4	4	4	4	4
2. ADAPTABILITY		4	4	4	4	4	4	4	4	4	4	4	4	4	4
3. SUITABILITY		4	4	4	4	4	4	4	4	4	4	4	4	4	4
	SUB TOTAL	12	12	12	12	12	12	12	12	12	12	12	12	12	12
V. SAFETY STANDARDS		5	5	5	5	5	5	5	2.5	4.5	5	5	5	5	5
	SUB TOTAL	5	5	5	5	5	5	5	2.5	4.5	5	5	5	5	5
	TOTAL	100	100	100	100	94.1	99.3	96.9	97.5	92.6	100	100	100	100	100

BUILDING RATING: 95 - 100 = (S)SATISFACTORY 75 - 94 = (2)REMODEL A 55 - 74 = (3)REMODEL B 35 - 54 = (4)REMODEL C 0 - 34 = (U)UNSATISFACTORY

PHYSICAL FACILITIES EVALUATION SUMMARY — DORMITORIES

EVALUATION CRITERIA		MAXIMUM POSSIBLE RATING	ACTUAL RATING LISTED BY BUILDING CODE												
			27 WI	28 MS	29 PI	44 EL	45 MC	46 MX	47 CO	48 DU	49 BR	50 EV	51 WA	100 MU	101 JO
I. PRIMARY STRUCTURE															
1. FOUNDATION SYSTEM		13	13	13	13	13	13	13	13	13	13	13	13	13	13
2. COLUMN & EXTERIOR WALL SYSTEM		13	13	13	13	13	13	13	13	13	13	13	13	13	13
3. FLOOR SYSTEM		7	7	7	7	7	7	7	7	7	7	7	7	7	7
4. ROOF SYSTEM		7	7	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	4.9	4.9
	SUB TOTAL	40	40	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	38.6	37.9	37.9
II. SECONDARY STRUCTURE															
1. CEILING SYSTEM		3	3	3	3	3	3	3	2	3	3	3	3	3	3
2. INTERIOR WALLS & PARTITIONS		3	3	3	3	3	3	3	3	3	3	3	3	3	3
3. WINDOW SYSTEM		2	2	2	2	1.4	2	2	1	2	2	2	1.4	2	2
4. DOOR SYSTEM		1	1	1	1	.8	.8	.8	1	1	1	1	.8	.9	.9
	SUB TOTAL	9	9	9	9	8.2	8.8	8.8	7	9	9	9	8.2	8.9	8.9
III. SERVICE SYSTEMS															
1. COOLING		10	10	10	10	8	9	9	9	8	8	7	8	9	9
2. HEATING		10	10	10	10	8	9	9	9	8	8	7	8	9	9
3. PLUMBING		5	5	5	5	5	5	5	5	5	5	5	5	5	5
4. ELECTRICAL		8	8	8	8	8	8	8	8	8	8	8	8	8	8
5. CONVEYING		1	1	1	1	.6	1	1	.5	.6	.6	.6	.6	1	1
	SUB TOTAL	34	34	34	34	29.6	32	32	31.5	29.6	29.6	27.6	29.6	32	32
IV. FUNCTIONAL STANDARDS															
1. ASSIGNABLE SPACE		4	4	4	4	4	4	4	4	4	4	4	4	4	4
2. ADAPTABILITY		4	4	4	4	4	4	4	4	4	4	4	4	4	4
3. SUITABILITY		4	4	4	4	4	4	4	4	4	4	4	4	4	4
	SUB TOTAL	12	12	12	12	12	12	12	12	12	12	12	12	12	12
V. SAFETY STANDARDS		5	5	5	5	5	5	5	5	5	5	5	5	5	5
	SUB TOTAL	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	TOTAL	100	100	98.6	98.6	93.4	96.4	96.4	94.1	94.2	94.2	92.2	93.4	95.8	95.8

BUILDING RATING: 95 - 100 = (S)SATISFACTORY 75 - 94 = (2)REMODEL A 55 - 74 = (3)REMODEL B 35 - 54 = (4)REMODEL C 0 - 34 = (U)UNSATISFACTORY

ACADEMIC & SERVICE BUILDINGS
PHYSICAL FACILITIES EVALUATION SUMMARY — BY CRITERIA — 1984

EVALUATION CRITERIA	MAXIMUM POSSIBLE RATING	BUILDING	ACTUAL RATING	DESCRIPTION OF DEFICIENCY
I. PRIMARY STRUCTURE				
1. FOUNDATION SYSTEM	13			
		HP	11.7	FOUNDATION WALLS CRACKED WATER SEEPS THROUGH WALLS
2. COLUMN & EXTERIOR WALLS	13			
		ES	11.7	CAULK, TUCK-POINT
		HP	11.7	NO INSULATION-EXTERIOR WALL
		JH	10.4	WATERPROOF, CAULK CLEAN, TUCK-POINT
		KH	10.4	WATERPROOF, CAULK, CLEAN, TUCK-POINT
		LB	11.7	COPING, GUTTER, WATERPROOF, TUCK-POINT
		WS	11.7	WATERPROOF, CAULK, CLEAN, TUCK-POINT
		15	10.4	WATERPROOF, CLEAN, TUCK-POINT
		179	12.7	WATERPROOF, CAULK
3. FLOOR SYSTEM	7			
		OM	6.3	CONCRETE SLAB ON GRADE
		US	5.6	V.A.T. NEEDS TO BE REPLACED OR REPAIRED IN OFFICE SPACES AND EXPOSED CONCRETE FLOOR IN PRINTING SERVICES. THE STEEL FLOOR GRATES NEED TO BE REPLACED OR REPAIRED.
4. ROOF SYSTEM	7			
		BN	3.5	NOT INSULATED, SHINGLES CRACKED
		BR	4.9	NOT INSULATED, SHINGLES CRACKED
		CH	4.2	NOT INSULATED, SHINGLES CRACKED SHINGLES USED FOR PATCHING ARE A DISSIMILAR TYPE

		EC	6.3	LEAK AT EAST WING
		JH	5.6	LEAKS IN SEVERAL PLACES
		KH	2.8	NO INSULATION, DISSIMILAR TYPE SHINGLES, SLATE SHINGLES CRACKED
		NS	3.5	DISSIMILAR TYPE SHINGLES, LEAKS IN SEVERAL PLACES
		PH	5.6	SOME SHINGLES MISSING, SHINGLES CRACKED
		178	3.5	NO INSULATION, LEAKS IN SEVERAL PLACES
II. SECONDARY STRUCTURE				
1. CEILING	3			
		HP	1.5	EXISTING CEILINGS IN CLASSROOMS NEED TO BE REPLACED. CEILING TILE AND METHOD OF ATTACHMENT NOT ACCORDING TO CODE
		KH	1.5	CEILINGS AND METHOD OF ATTACHMENT NOT ACCORDING TO CODE
		LB	2.1	CANE FIBRE MATERIAL IN SOME PLACES
		NS	1.5	CANE FIBRE MATERIAL IN SOME PLACES
		US	1.5	CANE FIBRE MATERIAL IN SOME PLACES
		WS	2.4	CEILING IN DRESSING ROOMS NEEDS REPLACING(ALSO IN ROTC CLASSROOMS)
2. INTERIOR WALLS & PARTITIONS	3			
		HH	1.5	TRANSOMS OVER DOORS
		HP	2.4	TRANSOMS OVER DOORS
		NS	2.4	PLASTER ON WALLS NEEDS REPAIR
		OM	1.5	PLASTER ON WALLS UPSTAIRS IS FALLING OFF UNDER WINDOWS(ALSO MAIN FLOOR AND BOILER ROOM).
		US	2.4	PLASTER ON WALLS IN OFFICES AND UPSTAIRS

3. WINDOW SYSTEM	2			
		EC	1.8	METHOD OF HOLDING WINDOWS IN PLACE DIFFICULT TO MAINTAIN
		KH	.4	AIR LEAKAGE EXCESSIVE
		LA	1	NEED TO BE REGLAZED
		NS	1	AIR LEAKAGE EXCESSIVE
		OM	1.2	NEEDS GLAZING AND PAINTING. SINGLE PANE & AIR LEAKAGE AROUND FRAMES
		US	.4	STEEL FRAMES AND SINGLE PANE. AIR LEAKAGE EXCESSIVE.
4. DOOR SYSTEM	1			
		BH	.2	1-EXT. DOORS NEED TO BE HUNG. TRANSOMS OVER DOORS
		FB	.2	DOORS AND FRAMES NOT ACCORDING TO CODE
		FH	.5	RETURN AIR LOUVERS IN DOORS
		HH	.2	TRANSOMS OVER DOORS
		HP	.8	NEED NEW LOCKS. TRANSOMS OVER DOORS
		KH	0	NEED TO BE REPLACED. NEED NEW LOCKS AND HARDWARE
		LA	.2	DO NOT MEET CODE. TRANSOMS OVER DOORS, NEED NEW LOCKS
		LB	.8	PANEL WITH GLASS. NEED NEW LOCKS
		LH	.5	PANEL DOORS DO NOT MEET CODE. NEW LOCKS
		NS	.5	PANEL DOORS DO NOT MEET CODE. NEW LOCKS
		OM	.7	NEED PANIC DEVICES
		US	.5	DOORS ON BACK OF HEATING PLANT SECTIONS NEED REPLACING WITH ROLL-UP OR OTHER INT. DOORS DO NOT MEET CODE

III. SERVICE SYSTEMS

1. COOLING	10			
2. HEATING	10			
		BN	8	CORRIDORS USED FOR RETURN AIR
			8	
		BR	8	CORRIDORS USED FOR RETURN AIR
			8	
		CH	8	CORRIDORS USED FOR RETURN AIR
			8	
		DH	7	SOME AREAS HAVE NO COOLING
			9	CORRIDORS USED FOR RETURN AIR IN SOME AREAS
		ES	9	NO CENTRAL SYSTEM
			9	POOR TEMPERATURE CONTROL
		FA	9	HUMIDITY EXCESSIVE
			9	
		FB	8	CORRIDORS USED FOR RETURN AIR
			8	
		FH	8	CORRIDORS USED FOR RETURN AIR
			8	
		HH	8	CORRIDORS USED FOR RETURN AIR
			8	
		JH	8	CORRIDORS USED FOR RETURN AIR
			8	
		US	7	NO COOLING IN SOME AREAS
			8	POOR TEMPERATURE CONTROL
3. PLUMBING	5			
		US	4.5	FIXTURES & PARTITIONS NEED TO BE UPDATED(ALSO NO VENTILATION)
4. ELECTRICAL	8			
		PR	7.2	NO EMERGENCY LIGHTING
		US	7.2	NEEDS ONE PANELBOARD IN PRINTING TO REPLACE 30 & 60 AMP SAFETY SWITCH. REPLACE EMERGENCY GENERATOR WITH A LARGER UNIT W/HIGHER WATTS OUTPUT.
5. CONVEYING	1			
		NONE		

IV. FUNCTIONAL STANDARDS				
1. ASSIGNABLE SPACE	4	LA	3.6	BUILDING DESIGNED FOR OTHER PURPOSES THAN PRESENT USE
2. ADAPTABILITY	4	LA	3.2	BUILDING DESIGNED FOR OTHER PURPOSES THAN PRESENT USE
3. SUITABILITY	4	LA	3.2	BUILDING DESIGNED FOR OTHER PURPOSES THAN PRESENT USE
V. SAFETY STANDARDS	5	BH	3.5	STAIRWELLS NOT ENCLOSED. EGRESS TO EXITS
		DH	4	EGRESS FROM BALCONY NOT ACCORDING TO CODE
		ES	4.5	HANDICAP ACCESSABILITY PROBLEM
		FB	3.5	STAIRWELLS NOT ENCLOSED. EGRESS TO EXITS
		FH	4	STAIRWELLS DO NOT OPEN TO OUTSIDE
		HH	3.5	STAIRWELLS NOT ENCLOSED. EGRESS TO EXITS
		JH	4	CORRIDORS USED FOR RETURN AIR
		KH	2.5	STAIRWELLS NOT ENCLOSED. EGRESS TO EXITS. BOTTOM FLOOR HAS NO METHOD OF EGRESS FROM THAT LEVEL
		LA	4.5	STAIRWELLS NOT ENCLOSED AT MAIN LEVEL
		NS	4	EGRESS TO EXITS
		US	4	NO HANDICAP ACCESSABILITY

DORMITORIES
PHYSICAL FACILITIES EVALUATION SUMMARY — BY CRITERIA — 1984

EVALUATION CRITERIA	MAXIMUM POSSIBLE RATING	BUILDING	ACTUAL RATING	DESCRIPTION OF DEFICIENCY
I. PRIMARY STRUCTURE				
1. FOUNDATION SYSTEM	13	NONE		
2. COLUMN & EXTERIOR WALLS	13	NONE		
3. FLOOR SYSTEM	7	NONE		
4. ROOF SYSTEM	7	QU	6.3	NO INSULATION IN ROOF SYSTEM
		JA	6.3	NO INSULATION IN ROOF SYSTEM
		MD	6.3	NO INSULATION IN ROOF SYSTEM
		MR	6.3	NO INSULATION IN ROOF SYSTEM
		SM	5.6	NO INSULATION IN ROOF SYSTEM
		MS	5.6	NO INSULATION
		PI	5.6	NO INSULATION
		EL	5.6	BUILDING HAS LITTLE OR NO INSULATION
		00045-MC	5.6	PHYSICAL COND.,LEAKS,DRAINAGE ON FLAT
		00046-MX	5.6	PHYSICAL COND.,LEAKS,DRAINAGE ON FLAT
		CO	5.6	NO INSULATION
		DU	5.6	NO INSULATION
		BR	5.6	NO INSULATION IN ROOF SYSTEM
		EV	5.6	NO INSULATION
		WA	5.6	BUILDING HAS LITTLE OR NO INSULATION

		00100-MU	4.9	PHYSICAL COND., LEAKS, NO INSULATION
		00101-JO	4.9	PHYSICAL COND., LEAKS, POOR DRAINAGE ON BUILT UP FLAT PART, NO INSULATION
II. SECONDARY STRUCTURE				
1. CEILING	3			
		00008-QU	2.7	WOOD FIBER LOBBY, APPEARANCE
		00009-JA	.3	PHUSICAL CONDITION, APPEARANCE
		00011-MR	2.1	WOOD FIBER LOBBY,APPEARANCE,PHY. COND.
		00020-SM	1.5	WOOD FIBER
		00047-CO	2	WOOD FIBER LOBBY, APPEARANCE
2. INTERIOR WALLS & PARTITIONS	3			
		00008-QU	2.4	APPEARANCE, PHYS. COND., MAINTAINANCE
		00009-JA	2.4	APPEARANCE, PHYS. COND., MAINTAINANCE
		00011-MR	2.4	APPEARANCE, PHYS. COND., MAINTAINANCE
3. WINDOW SYSTEM	2			
		QU	1.6	BUILDING HAS DOUBLE HUNG WINDOWS
		JA	1.6	BUILDING HAS DOUBLE HUNG WINDOWS
		MILLER-MR	1.6	PHYS. COND.,APPEARANCE,SINGLE GLAZING INFILTRATION, MAINT., DOUBLE HUNG
		EL	1.4	WINDOWS - DOUBLE HUNG
		CO	1	WINDOWS - DOUBLE HUNG
		WA	1.4	BUILDING HAS DOUBLE HUNG WINDOWS
4. DOOR SYSTEM	1			
		QU	.5	HARDWARE, SECURITY, NO FIRE RATING
		JA	.5	HARDWARE,SECUR.,NO FIRE RATING,KEYING
		MR	.5	HARDWARE,SECUR.,NO FIRE RATING,KEYING
		EL	.8	HARDWARE, SECURITY, NO FIRE RATING
		MC	.8	HARDWARE,SECUR.,NO FIRE RATING,KEYING
		MX	.8	HAREWARE,SECUR.,NO FIRE RATING,KEYING
		WARF-WA	.8	HAREWARE,SECUR.,NO FIRE RATING,KEYING

		MU	.9	DOOR MAGNETS NEED TO BE INSTALLED ON STAIRWELL DOORS, SECURITY, KEYING
		JO	.9	DOOR MAGNETS NEED TO BE INSTALLED ON STAIRWELL DOORS, SECURITY, KEYING

III. SERVICE SYSTEMS

1. COOLING	10			
2. HEATING	10			
		SM	8	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL.
			8	NO HUMIDITY CONTROL.
		EL	8	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH WARF HALL.
			8	NO HUMIDITY CONTROL. HEATING SYSTEM COMMON WITH WARF HALL
		MC	9	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH MADDUX HALL.
			9	NO HUMIDITY CONTROL. HEATING SYSTEM COMMON WITH MADDUX HALL.
		MX	9	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH MCCORD HALL.
			9	NO HUMIDITY CONTROL. HEATING SYSTEM COMMON WITH MCCORD HALL.
		CO	9	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH DUNN HALL.
			9	NO HUMIDITY CONTROL.
		DU	8	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH COOPER HALL.
			8	NO HUMIDITY CONTROL. HEATING SYSTEM COMMON WITH COOPER HALL.
		BR	8	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH EVINS HALL.
			8	NO HUMIDITY CONTROL. HEATING SYSTEM COMMON WITH EVINS HALL.
		EV	7	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL.
			7	NO HUMIDITY CONTROL.

		WA	8	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH ELLINGTON HALL. LINES HAVE DETERIORATED TO THE POINT THAT THEY NEED TO BE REPLACED AS SOON AS POSSIBLE.
			8	NO HUMIDITY CONTROL. HEATING SYSTEM COMMON WITH ELLINGTON HALL. LINES HAVE DETERIORATED TO THE CONDITION THAT THEY MUST BE REPLACED AS SOON AS POSSIBLE.
		MU	9	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH JOBE HALL.
			9	NO HUMIDITY CONTROL. HEATING SYSTEM COMMON WITH JOBE HALL.
		JO	9	NO ECONOMIZER CYCLE. NO HUMIDITY CONTROL. COOLING SYSTEM COMMON WITH MURPHY HALL.
			9	NO HUMIDITY CONTROL. HEATING SYSTEM COMMON WITH MURPHY.
3. PLUMBING	5			
		JA	4	NO WHEELCHAIR FACILITIES
4. ELECTRICAL	8			
		NONE		
5. CONVEYING	1			
		EL	.6	NO PNEUMATIC TUBES. NO DUMBWAITER.
		CO	.5	NO PNEUMATIC TUBES. NO DUMBWAITER.
		DU	.6	NO PNEUMATIC TUBES. NO DUMBWAITER.
		BR	.6	NO PNEUMATIC TUBES. NO DUMBWAITER.
		EV	.6	NO PNEUMATIC TUBES. NO DUMBWAITER.
		WA	.6	NO PNEUMATIC TUBES. NO DUMBWAITER.

IV. FUNCTIONAL STANDARDS

1. ASSIGNABLE SPACE	4	
		NONE
2. ADAPTABILITY	4	
		NONE
3. SUITABILITY	4	
		NONE

V. SAFETY STANDARDS	5			
		CR	2.5	ALARM SYSTEM NEEDS UPDATING. EMERGENCY LIGHTING NEEDS UPDATING. NO HANDICAP RESTROOM FACILITIES.
		SM	4.5	NO HANDICAP FACILITIES

COMPARATIVE DATA
ACADEMIC AND SERVICE BUILDINGS

Building Number and Name	Ratings		
	1976	1980	1984
BN-Bartoo	91.9	92.4	97.7
BN-Brown	96.0	93.6	92.5
BR-Bruner	96.0	92.3	89.9
CH-Clement	98.0	94.0	93.2
DH-Derryberry Hall	96.7	94.2	94
DN-Daniels	33.3	40.2	100.0
EC-Hooper Eblen Center	-	99.1	99.1
ES-Football Stadium East	92.4	95.8	96.2
FA-Bryan Fine Arts Building	-	-	98
FB-T. J. Farr	86.3	91.2	93.7
FH-Foster Hall	96.7	92.5	94.5
FN-Foundry	83.8	89.3	100.0
HH-Henderson Hall	88.3	92.5	92.2
HP-Health and Physical Education	87.1	68.1	95.1
IT-Lewis Hall	86.1	83.5	99.5
JH-Johnson Hall	96.0	91.9	91.0
KH-Kittrell Hall	92.9	88.1	86.6
LA-Library Annex	84	91.0	95.7
LB-Library	76.1	97.0	97.6
MH-Matthews Hall	69.5	69.6	100.0
NS-Nursing School	52.7	72.1	91.9
OM-Old Maintenance Building	38.9	87.6	96.7
PH-Prescott	100.0	100.0	98.6
PR-Pennebaker	100.0	100.0	97.2
UC-University Center	91.8	99.6	100.0
US-University Services	84.8	84.8	87.1
WS-Football Stadium West	92.4	99.6	100.0
00015-Infirmary	74.5	72.3	97.4
00176-Maintenance Office Building	100.0	100.0	100.0
00177-Maintenance Shops	100.0	100.0	100.0
00178-Warehouse	100.0	100.0	96.5
00179-Garage	99.7	99.7	99.7
00180-Chiller Plant	100.0	100.0	100.0

COMPARATIVE DATA
DORMITORIES

Building Number and Name	Ratings 1980	Ratings 1984
00006-Wheeler Hall	89.7	100.0
00007-Austin Hall	98.7	100.0
00008-Quentin Hall	89.7	97.5
00009-James Hall	89.7	96.8
00010-Millard Hall	89.7	99.3
00011-Miller Hall	89.7	96.9
00012-Crawford Hall	83.3	97.5
00020-Smith Lodge	92.1	92.6
00022-Rye Hall	98.8	100.0
00023-Dixie Hall	98.8	100.0
00024-Early Hall	98.5	100.0
00025-Meadows Hall	98.5	100.0
00026-Marshall Hall	83	100.0
00027-White Hall	83.8	100.0
00028-M.S. Cooper Hall	99.5	98.6
00029-Pinkerton Hall	99.5	98.6
00030-President's Residence	100.0	100.0
00044-Ellington Hall	99.5	93.4
00045-McCord Hall	99.5	96.4
00046-Maddux Hall	99.5	96.4
00047-Cooper Hall	99.5	94.1
00048-Dunn Hall	99.5	94.2
00049-Browning Hall	99.5	94.2
00050-Evins Hall	99.5	92.2
00051-Warf Hall	99.5	93.4
00100-Murphy Hall	98.2	95.8
00101-Jobe Hall	98.1	95.8

Managing the Process of Facility Management

By Kenneth A. Hall
Director of Physical Plant
University of Idaho

Ladies and Gentlemen, I want to start by making this statement. The effective Physical Plant Director must be an individual who seizes the responsibilities of that position and responds with vigor. The director needs to shift the center of focus of the position to results and responsibilities. Directors must go on the offensive using sound management tools and taking an active part in the leadership roles of the institution. Those individuals responsible for management of the institution's facilities must lead the process of developing the annual facility action plans to achieve the institution's goals. Tools that can help the director lead are contained in budget management and group dynamics.

The purpose of today's presentation is to provide impetus for development of a management plan, not to detail specific management tools. I intend to lay before you examples of tools that can be used to enhance the management process. The development of strategies, the assessment of results, the refinement of responsibilities and the achievement of goals to motivate the Physical Plant service efforts are all essential for the success of your operation. However, bear in mind that systems alone do not ensure an effective environment for successful effort.

The role of the Physical Plant will vary from institution to institution in technicalities only. The basic theme of every Physical Plant must be service. The Physical Plant must be easily identified in order to proceed with a program that reflects a positive image. The mission statement for the Physical Plant at the University of Idaho is:

> The Physical Plant, through the efforts of its staff and management program, shall take all necessary steps to ensure that the University of Idaho has appropriate space to carry out its roles of research, teaching, and public service. The condition of the buildings, the grounds, and the infrastructure will provide for a positive environment to enhance the efforts of the faculty,

> staff, students, and public to carry on their responsibilities. The campus will be maintained and operated so that the surroundings are aesthetically pleasing, safe, and comfortable. New facilities and additions, infrastructure expansion, building and grounds renovations and remodelling activities will be accomplished in harmony with the historical nature of the campus. The Physical Plant staff will carry on its daily tasks providing leadership and support for the proper use of our investment in facilities while making every effort to preserve their usefulness for the future.

The topic that I am presenting today hopefully will generate and stimulate thoughts and questions about your role as Physical Plant director or as an administrator on your campus. When I have finished the presentation, I am hopeful we can take a few minutes to discuss some of the concepts set forth in today's presentation.

Introduction of Home Institution

The University of Idaho is a land grant university located in Moscow, Idaho, better known as The Palouse. The University of Idaho is situated on numerous rolling hills of The Palouse and, interestingly enough, only nine miles from Washington State University which is also a land grant institution. The closeness of our relationship is more than geographic, but that is a topic in itself, and I do not have time to discuss it today.

Our land grant university is made up of nine colleges representing the Letters and Science program; Agriculture; Engineering; Law; Mining and Earth Resources; Forestry, Wildlife and Range Sciences; Education; Business and Economics; and Art and Architecture with the appropriate support services associated with such collegiate programs. We also have a research mission which is headed up by the Dean of the Graduate School.

The student population is approximately 9,000 full-time students, a support staff of 2,000 and a faculty of 600. We also offer a number of programs in other locations in the State. The physical size of our campus is 53 major buildings and 492 developed acres. We also have immediately adjacent to our developed acreage another 1,500 acres assigned to the agricultural and veterinary science programs. Furthermore, we have a 7,000 acre forest located approximately 20 miles from the campus and a research farm containing another 200 acres, 3 miles from the campus.

The University of Idaho Physical Plant is made up of a director, deputy director, superintendent of buildings, superintendent of grounds, construction manager (responsible for the supervision of large construction projects and the management of the shops operations which is a charge-back self-supporting entity), and a mechanical engineer responsible for the supervision of the utilities/HVAC programs and energy conservation activities.

The Physical Plant staff totals 165 full-time employees with 20 part-time employees. Seasonal fluctuations of 80-120 part-time persons are normal.

Role and Mission Statements

Most universities and college campuses have a governing board that sets the missions for the institution. Our mission is established by the Board of Regents for the University of Idaho. Within that mission statement the University of Idaho has been identified as the primary institution for the State with emphasis on research activities, instruction and public service.

The mission for the Physical Plant evolved from this framework. Once our statement of mission was accepted by the senior administration, we could more clearly identify the basis upon which to build our programs and develop budget priorities.

Defining the Role of the Director of the Physical Plant

To begin with, you must first know who you are. You must clarify and refine your management style. Determine if you are a good player, or are you a leader? Leaders develop loyalty, and even though everyone won't love you, everyone should respect you. Make every effort to surround yourself with a support staff of individuals more skilled and expert in their fields than you are. Then delegate authority and responsibility, letting them make mistakes and learn from them.

Do the best you can with each situation, make a decision based on the best information available and then move on to the next issue. Don't waste your time and energy on past decisions. As Kenneth Blanchard, author of The One-minute Manager, says, "Expend your energy on the positive and correctable situations. Make something happen! Enjoyment and excitement should be a part of your life every day. Also make your talents available to those less fortunate."

As the President of Bank of America once stated, "Be proud of whoever and whatever you are--stand up for 'you'. Take risks; however, explore all possibilities and ideas to lower the risk factors. And, above all else, keep your morals intact."

As a director you must be sensitive to the needs of others. Make people feel comfortable and good about themselves. Stay in touch with what is happening, not only within your own community but the outside world. Be well traveled, read a wide range of subject matter, and experience life. No matter what the age or education difference there may be between you and the others you touch, look for a common ground.

The director must develop lines of communication with deans and department heads and the other administrators from the president on down through the organizational chart. It is the responsibility of the Physical Plant Director to establish those lines of communication and deal with all of the other appointed leaders in an effective manner.

I don't know how many of you saw the movie, "The Empire Strikes Back," however, there was a scene in that movie that meant a lot to me, because of its profound philosophical base. The movie scene was of Yoda talking to Luke after Luke had crashed to a swamp on a stellar body. Luke was trying to move his space ship with mental powers that he had received from The Force, but to no avail. He responded to Yoda that he couldn't do it regardless of how hard he tried. Yoda retorted, "No, don't try, either you do or you don't do, there is no try." Luke's retort was, "I don't believe it." And Yoda in turn responded, "That is why you failed."

If we don't DO in all of the aspects as an appointed leader on campus, then we too will fail. If we don't believe in ourselves and those individuals on our staffs, we will fail. How do we go about "doing?" People talking to other people is what gets things accomplished. Frederick Volkman in the April 1985 issue of Current Magazine, wrote an article titled, "Avoiding the Impersonal Touch." In that article he stated the following activities are important in descending order in developing an effective way to communicate an institution's message.

An effective communicator first must: Meet with a person in a one-to-one, face-to-face conversation to be most effective. If this is not possible, proceed to a small group discussion or meeting. The third most effective way is a person speaking before a large group. Telephone conversation, and then handwritten and personal notes are fourth and fifth in effectiveness. If you do not have time for this, then have your memo typed, making sure it is a personalized letter and not generated by a computer. A more distasteful "computer generated" personal letter, or if you really want to become impersonal, try mass produced non-personal letters are some of the least effective communication tools. Brochures by direct mailing, an article in an institutional letter or magazine, and news carried in a mass media format, such as newspapers, radios, TV's or magazines are some of our least effective ways to communicate. Advertising through mass media and posters, and billboards, or other less personal forms of communication are very ineffective for our type of work.

We must make the time to meet with various other departments on campus. Whenever possible, meet with department heads on their turf, in their setting, allowing them to be the host. Discuss with them whatever is important to them and listen. We should strive to hold these one-to-one meetings no less than once annually. Move to your lesser forms of communication also, and use them frequently. Attempt to stay in touch by letter, report, memo and telephone conversation. If at all possible, an occasional walking tour of their space and adjacent areas is very beneficial for you to demonstrate the effectiveness of your department, and you in turn can get a sense of their department.

Identify the roles of the other departments on campus and the impact that they have on your operation. Develop your lines of communication with those other support functions such as the business office, purchasing, personnel, payroll, and controller's office. You need to have solid lines of communication with them so that you can conduct your business effectively. Take the initiative, develop the leadership that is necessary to promote success for your organization. There are times when you will need to draw from the risk manager, the motor pool operator, the telecommunications director, the computer services supervisor or the budget officer. You will need them just as much as they need you. It is in your best interests and the goals of your organization to operate from a knowledgeable base. Manage the process, don't let it manage you.

There are many subtle methods, and others not quite so subtle for lines of communication. The work order system and job scheduling programs can be utilized to form a base of communication to all departments on campus. By establishing project schedules and critical points of accomplishment, you identify a team role with the other department heads. The onus, however, is upon you to manage these critical points. Provide cost estimates and charge back information, demonstrating that you are a manager, that your support people are managers, and that you know what you are talking about. Project management and decision making must be done at a level that is clearly understood by all in your group.

Computer Applications That Enhance the Communication Process

Over the past three years, we have developed an electronic networking system that stretches campuswide. This networking allows our department and all other departments on campus access to instant communication.

The coordinated networking of computerized equipment and software management systems provide the opportunity for an institution to have the most sophisticated systems known to man today. At the University of Idaho we have been most fortunate in installing one of the most sophisticated electronically managed systems that exist on any campus in the country. For the past several years, in striving to build a management support system that addresses two important objectives, 1) we have targeted ways to improve the effective, efficient use of the resources made available to the university and 2) expand the productivity of our current staff as a higher priority than adding new staff in response to the growth of the university's business.

To give you an example, the Physical Plant's maintenance and operations program funding has increased from $250,000 to over $2.5 million in the last four years. We have managed to increase our record keeping and management reporting systems by the utilization of an electronic program. Our work order system is designed to allow us to provide all persons on the campus the detailed information about maintenance and construction work going on in their building. Our current staffing level has been increased by only one additional person from four to five, even though our project level has increased tenfold. We have one administrative assistant, one secretary, one accounting technician, one work control center clerk, and two part time clerks take care of our entire clerical, secretarial workload for the Physical Plant.

Our electronic mailing systems, billing systems, scheduling systems allow us to communicate instantly with any department on campus. Our electronic management system has been developed around the technologies of word processing and office automation. Our word processing permits creators of documents to electronically rewrite these documents and send them on to another office without the laborious task of numerous rewrites in the development of documents.

Furthermore, we have developed our systems so that we have instant communication with our branch programs in other areas of the state, with Boise State University, located 300 miles from the University of Idaho; Idaho State University, located approximately 600 miles from the University of Idaho; Lewis Clark State College, located 30 miles from the University of Idaho and Washington State University, located 9 miles from the University of Idaho.

At the present time I am able to send information to the State Board or the Legislative office or the Governor's office electronically, and from my office to the State budget technicians with the press of a button.

In addition to this massive communication network, many of us in the Physical Plant have our own microcomputers sitting on our desk which are linked internally with our own programs designed to meet our specific needs.

Encourage the Faculty, Staff and Student Body to Support the Role and Mission of the Physical Plant

The Physical Plant Director needs the full support, not only of his own staff, but that of faculty, other departmental staffs and the student body. It is his responsibility to solicit the support for the role and mission of the Physical Plant from these other groups. This can be accomplished through effective use of a planned public relations effort. Someone in your department should be made responsible for the development and publication of articles in university publications and local newspapers. If you have television available, then efforts should also be made to develop contacts within that media to gain high visibility of your department. Through these efforts attention can be brought to the needs of the Physical Plant and develop a better understanding of the role and mission of your operation.

Personnel recognition and special program accomplishments can be amplified through award ceremonies and letters of commendation to individuals that are made publicly known. Encourage other departments, with your support, to develop orientation sessions for other administrators on your campus. Also, new orientation sessions can be developed to inform new employees of the best way to obtain the services of the Physical Plant on a regular basis. The more individuals that you develop on the campus who have an understanding of your role and mission and can identify with your functions, the easier your job will be.

Set up sessions with other departments and their support staffs providing them with an opportunity to critique the delivery of your services. Make it a no holds barred session, which at times may be very painful; but if conducted in a professional manner, will be very beneficial for you and your staff. This will also provide an opportunity for your organization to grow for the benefit of all others on campus.

When requests come to you or your staff members, they should be responded to immediately regardless of size or appearance of importance. No problem should be treated as too big or too small. Return phone calls promptly and don't let anything sit on your desk for longer than 24-hours without some type of positive reaction to it. Either assign it to an individual on your staff or form a task force to address the issues if you cannot handle the problem yourself in a timely manner. The department requesting the need should be made aware of the assignment of any of these responsibilities so the department head knows that some action is being taken and with whom they are to work.

Develop a sense of community within your own operation through making yourself and other administrators on your staff visible on campus. This can be done by supporting other departmental functions and participating in university wide activities. Attend and encourage others of your staff to attend so that you may develop a sense of the university community and a sensitivity to all the programs that are offered on campus. The better feeling you have about the university environment, the better you will be able to respond in a support role.

In order to manage the institution's facilities in concert with its major programs, it is very important that the director of the Physical Plant establish an effective communication process with his senior administrative officers at the institution. With respect to developing this process, a communication system needs to be developed through regularly scheduled sessions with senior administrative officers regarding projects, budgets, completion schedules and impact of other departmental programs.

Tours of the campus and some specific projects are highly warranted and desirable to provide an opportunity for the director to refine his management style with respect to the desires of the president and vice presidents. An opportunity is also afforded during these talks to identify points of interest and emphasis that those administrative officers wish to see completed.

Effort must be made in the area of short-range and long-range planning. If your institution does not already have a process whereby opportunities for providing facility information are available to all departments, then you should take the initiative attempting to work with each department to develop short and long-range plans. In this way you will be aware of campus program modifications as they affect your operation and be in a better position to respond in the affirmative instead of being in the reactive posture. This prevents having to react to crisis situations. According to Kenneth Blanchard, author of the One Minute Manager, "The most important part of goal setting is seeing yourself achieving a particular goal. Once we begin to visualize our goals, it is amazing how strategies and tactics start us moving toward our goals."

All of these concepts are effective as long as you have the accountability and responsibilities clearly defined with respect to your role as the director of the Physical Plant. You must develop with your immediate supervisor conceptual basic positions. Then you can operate within those parameters without having to return to your supervisor for direction and guidance. You will be able to carry out your functions with the full knowledge that you are working within your sphere and that your supervisor will support you as long as you carry out your professional responsibilities.

A clear understanding of your personal limitations and those of your staff and the expectations of your supervisor need to be developed, not only on individual projects, but on day-to-day responsibilities. The freedom to move about the university community with a clear understanding of your role allows you to communicate that role to other individuals without overstepping your authority and still be able to deliver results when needed.

On the opposite side of the spectrum, making the people and the work they do more effective is also a responsibility that the Physical Plant director accepts. By utilizing a team concept of management for your staff, your mid-management personnel will be able to relieve the pressure from the director. You will be able to accomplish many of the routine responsibilities of the director. You will be able to assign responsibilities and the authority to carry them out to various staff members, being assured that they are familiar with the overall programs and accomplish the goals of the other university administrators, as well as your own desires.

The employees and other support staff need to develop a sense of pride and clearness of mission. This can be accomplished through special training seminars and regularly scheduled meetings. These staff members will be able to develop the judgment necessary for them to do their job effectively.

Image awareness must be part of the training program. A sensitivity to the importance of the job that each Physical Plant employee fulfills is vital. This awareness must be imparted to them in training sessions, not in just once-a-year memos. Furthermore, each employee must be given the proper tools and equipment along with increased capability through proper training to do their job in the most effective way possible.

Too often excuses and rationalizations get in our way of properly performing our jobs. Getting the job done, in spite of the obstacles, is the primary objective of the Physical Plant director. Even without clear directions and adequate funding, we must be able to maintain our facilities and provide the support services necessary so the other departments on campus can do their jobs. Without a clear role and mission statement for the institution and the Physical Plant, we still must plan and define our scope of operation necessary to do our jobs.

The lack of administrative support from superiors, poor communication procedures, negative attitudes and pessimistic support must all be countered with a positive programs from you and your staff members. You must continue to work with all of your superiors and attempt to refine the communication process. Through time, positive approaches will develop the effectiveness of the Physical Plant director.

The director must replace the reactive process of management with an action plan and a program that allows the Physical Plant to take the offensive in managing its functions. Utilizing action plans related to short and long-range planning for facility management will make the job much easier and eliminate many of the brush fires that are inherent in our jobs.

Make the effort to develop a planning process that incorporates communication procedures for your department and other departments on campus. This should include the vice presidents and the president. From these guidelines develop the actions plans required to accomplish your programs. Develop interactive programs that allow your operation, your staff members and other departmental staff members on campus to meet to discuss common interests and goals for the institution. Eliminate the negative impact of reactive programs by planning and nurturing an understanding relationship between yourself and other administrators on campus, clearly defining the roles and functions each of you has.

Through the campus wide development of a capital facilities needs plan, you have the mechanism to develop institutional relationships with other managers. This planning process will provide a means to categorize needs and to ascertain the directions of the institution's development. All of the deans, directors, and managers have specific concerns for their own areas and for the institution in general. Those needs can then be identified and sorted in a group effort. Departmental funds and other funding sources then can be identified so that everybody is striving for the common goals. The use of long range goals and a formal master plan will make it much easier for you and others to move forward with your mid-managers knowing full well what the parameters are for the expenditure of time and money on your campus.

Develop a program that utilizes the information obtained from the building users through a facility audit process. Building managers can be identified within your staff and this program can develop an immediate source of information with respect to the needs of the users in the various buildings on your campus. Communications can be developed that will insure timeliness of response to problems and accuracy of information to resolve issues. It is also important that these individuals be given the proper training and equipment to do their jobs. The use of Dr. Kaiser's program for facility audits is just one of many tools available to us today to establish facilities needs and understand how they are meeting or not meeting their intended programmatic designs. These facility audits can then be used to provide a dialogue for funding of maintenance and remodel projects that are in compliance with long range needs of the academic programs.

Conclusion

In summary, I would like to repeat a number of points with the use of who, what, why, where and when. If you, as the director of the Physical Plant, and your staff can identify who you are, why you are doing the tasks you are doing, what you expect to accomplish with these tasks, where they fit into the overall plan for the university, and determining when you are most effective, you will then know how well you are accomplishing your job. You, in fact, will be managing the process of facility management and not having it manage you.

I thank you for the opportunity to address you today, and now I would like to open the floor to discussion.

OLDER BUILDINGS NEED AND DESERVE SPECIAL CARE

By Jerry G. Stockbridge
Vice President
Wiss, Janney, Elstner Associates, Inc.

If you are fortunate enough to have some well designed and constructed old buildings at the central core of your campus, you are indeed fortunate. It is these sound, well maintained, older buildings that give your college character and a sense of stability that a new campus cannot hope to emulate. These older structures usually do not warrant restoration programs equal to those we give our national landmarks, but they do need and deserve a maintenance and repair program tailored to their needs which very likely will be quite different from the maintenance programs for the rest of the newer buildings on your campus.

Some Examples of Problems

Water leakage and water induced deterioration are probably the most common problems encountered in older buildings. There are a number of reasons for this. The masonry walls of our older buildings frequently have design details which encourage the entry of water. Turrets, pinnacles, balustrades, cornices, ornamental belt courses, etc. which were in vogue and widely used in the past have many horizontal surfaces, pockets and depressions which at worse hold water or at best drain very slowly. The severe concentration of masonry deterioration which often occurs directly below these types of details clearly demonstrates their potential for water induced problems. Old walls were seldom constructed with flashings and weepholes to carry out the water which enters the walls as we would today and finally the masonry walls of old buildings are often so massive that they can take in substantial amounts of water without it working its way through to the interior to alert the occupants of the building that repairs are required. This abundant undetected water can deteriorate the masonry, corrode embedded steel members and rot out the ends of wood beams.

Even though the indiscriminate widespread application of fairly impervious coatings to masonry surfaces is not recommended and has caused irreversible damage to some buildings, experience has demonstrated that they can be used to improve the watertightness of horizontal surfaces at particularly troublesome locations if carefully selected from compatability with the existing materials. To allow moisture to evaporate from the masonry, it is often essential that the coatings not be applied to the face or the underside of the elements. Laboratory tests can be performed to determine the absorption rate of the original materials, the effect of the coatings on absorption and breathability, the susceptibility to freeze-thaw deterioration, and the probability of success of the repair.

Where poorly draining areas have deteriorated to the extent that substantial reconstruction is required, flashings and weepholes should be incorporated during the repair. It is also desirable to incorporate a more modern corrosion resistant anchorage system than to duplicate the unprotected black steel of the original installation.

Concealed roof gutters, balconies and downspouts buried in walls are extremely difficult to maintain and are also frequently sources of water induced problems in old buildings. Modification of these details during renovation to improve serviceability should be considered. Additional downspouts can be added to concealed gutters at problem areas, and mesh or screening can be installed over them to help keep out debris. Scuppers can be added to better drain balconies, or in some cases if details permit, the balconies can be covered over with pitched roofs which can be concealed by the ornamental railings and are not visible from the ground. Downspouts which are buried in the walls can be abandoned and be replaced with new downspouts moved to the interior of the building preferably in chases accessible for maintenance.

When the need for improving the watertightness of an old masonry element is in doubt or the source of a water entry cannot be visually determined, tests can be performed to get the answers. A calibrated solid conical spray head can be used to look for leaks., Moisture meters can be used to locate channels of water flow within walls. Tests can be performed in accordance with ASTM E514 to determine the actual ability of a particular surface to resist the penetration of wind driven rain.

All moisture problems in old buildings are not caused by water entering the walls from the outside. Changes of internal use which significantly increase the level of the humidity within a building can sometimes provide enough moisture to cause damage. In cold weather, moisture vapor in the building will normally move through the exterior walls to the outside. If the amount of water is excessive, it can cause freeze-thaw deterioration at exterior surfaces. Glaze brick and terra cotta walls which normally have fairly poor breathability are particularly susceptible.

In cases where the unusually high humidity in a building is suspected to be the cause of a problem, moisture probes can be embedded at strategic locations to study the migration patterns of the moisture vapor in the walls to aid in developing an effective repair. The probes can be left in the walls for extended periods of time and the data can be collected by an unattended data acquisition system. Problems associated with moisture vapor migration can frequently be solved by the installation of vapor barriers, venting of cavity spaces, changing the location of the dew point in the walls by the addition of strategically placed insulation, or a combination of the above.

Extremely dry interior air can also cause problems in older buildings by drying out wood members causing them to split longitudinally at points of weakness. This condition normally becomes of greatest concern in old wood trusses with bolted connections. The point of weakness where the splits normally develop in these old trusses is right through the bolt holes in the long top and bottom chord members. During the record snowfall of 1979 in Chicago, more roof collapses occurred in old buildings with wood trusses than in all other types of roof combined. In most of the 60 plus roof collapses we investigated that winter, the snow loadings on the roofs which triggered the collapses were lighter than the specified code roof loading. Drying splits through bolt holes was the most common cause of strength loss in the wood truss that we examined. The condition of wood trusses in old buildings should be inspected periodically, and if drying splits are observed, their significance should be evaluated by a structural engineer and repairs made if necessary.

Another lesson learned during the same snow of 1979 was the need for carefully considering all of the secondary effects of making significant changes to old buildings. Because of rising energy costs, a number of owners insulated the roofs of their old buildings which had never been well insulated before. The increased insulation in the roofs prevented the melt off of snow which had occurred in earlier years and the greater build up of snow which occurred caused some of the marginal roofs to collapse.

Stabilization

Acid rain is particularly detrimental to old building facades of materials containing high percentages of carbonates such as limestone and sandstone. Old stone materials which once weathered very slowly are now sometimes decaying at a rapid rate. Initial attempts a chemical strengthening of stone concentrated on the use of organic resin compounds which glued surface particles together and often densified the surfaces to the extent that the natural breathability of the stone was severely impaired and spalling occurred.

Chemical treatments are now available which have worked successfully on carefully studied and planned applications. The treatments have been able to replace the natural binder in the stone, without adversely effecting its natural breathability. Once original ornamentation has eroded away it is normally impractical to replace short of replacing the entire unit. On old buildings where rapid erosion is apparent it is foolish not to study the feasibility of using a chemical treatment as part of the buildings ongoing maintenance program.

Pros and Cons of Restoration

Restoration is the repair or replacement of materials with new materials which are exactly the same as the original or are as close to the original as possible. This approach often even extends to trying to actually duplicate the original methods of construction like slaking lime putty for mortar rather than using readily available prepackaged prehydrated lime. Restoration of this type may be justifiable for our national landmarks, but the increased repair costs and frequently poor serviceability of some old materials does not seem to be warranted or justifiable for many of our fine old buildings.

Where restoration is not warranted or economically feasible, renovation with new materials and construction techniques which achieve the same appearance should be considered. New polysulfide and polyurethane sealants can be used in place of the old oil base caulks, look the same, but perform much better and have substantially longer life. In areas of severe exposure, tuckpointing or repairing with modern portland cement-lime-sand mortars, which are carefully designed to be compatible with the original masonry units, can perform far better than if an old lime mortar is reused. Properly designed modern mortars can greatly improve old walls durability and reduce maintenance costs without causing any visual change in their appearance.

In most cases, it is probably desirable to replace the severely deteriorated stones, bricks or blocks in old masonry walls in kind when possible. When ordering replacement materials, today it is often necessary to have much more comprehensive specifications than were used when the materials were originally manufactured. For example, one old specification we have read simply required that the terra cotta be "as strong as necessary." Architects today who have written repair specifications which have simply read "match existing" have not always obtained the desired results.

If it is decided to use units of substitute materials instead of replacement in kind because of availability or cost, the units should be selected with great care. There are many substitute materials being used today. Some have worked well and some have not. Among the materials being used are precast concrete, polymer concrete, fiber reinforced concrete, fiber glass, plastics and several proprietary products. Accelerated weathering tests are very useful not only in evaluating the probable performance of substitute materials but also in assessing the visual compatibility of original and substitute materials as they accumulate dirt and weather. A comprehensive accelerated weathering test may include freeze-thaw exposure, simulated acid rain, environmental contaminants, ultraviolet and infrared exposure and wind blown dirt. It is often possible to simulate ten years of weathering in about two months.

Cleaning

When cleaning old buildings, extreme care must be taken to specify techniques which will not irreparably damage surfaces. Over zealous cleaning may produce the desired effect for the present, but may severely damage the surface causing accelerated deterioration in the future. Generally, methods can be categorized as either water, abrasive or chemical cleaning.

Water cleaning entails the application of steam or water under pressure. The pressure utilized and the length of application may vary to achieve uniform results. The intention of all water cleaning techniques is to loosen dirt particles and rinse them from the building. However, the relatively large quantities of water required may sometimes have adverse effects on metal anchorages or may result in water penetrating into interior spaces.

Abrasive cleaning typically entails the application of an aggregate under pressure. The type of aggregate employed and the application pressure can be varied to produce the desired results. The abrasive action of the aggregate wears down the dirt particles and they are blown from the building. The abrasive action may result in the loss of portions of the surface of the material being cleaned. Abrasive cleaning of old buildings is frequently not desirable.

In the past, most chemical cleanings were performed with diluted solutions of either hydrochloric (muriatic) acid or hydrofluoric acid. Today, numerous types of proprietary cleaners are available. Many of these cleaners are specially formulated for use on particular masonry materials and for the type of dirt encountered. Ideally, chemical cleaners react with the dirt particles while having minimal affect on the building material and allowing them to be rinsed away. To aid in the selection of the optimum chemical cleaner, it is often desirable to determine the composition of the particular dirt or stains which have to be removed. This can readily be done by subjecting representative dirt samples to x-ray diffraction and examination under a scanning electron microscope.

To insure that surfaces are not damaged during cleaning, representative test areas can be cleaned and examined petrographically. Petrographical examination of cleaned and adjacent uncleaned surfaces can frequently detect significant damage not readily apparent to the naked eye.

Maintenance Program

The most important first step in developing an effective maintenance program for your old building is to keep good records. If you are fortunate enough to have any of the original architectural drawings, reproducible copies should be made and stored in a safe place. Any documentation available on repairs or maintenance which has been performed over the years should also be copied and kept with the drawings. This data bank will be of immense value in determining the cause of problems and evaluating repair options in the future.

Old buildings frequently require ongoing maintenance at more frequent intervals than new buildings. Some old buildings have gone 10 to 15 years with the need for no maintenance; while others have demonstrated, through reoccurring problems, that they need at least some maintenance yearly. If you do not have good maintenance records to determine the performance characteristics of your buildings, it is probably prudent to set up a program with fairly short intervals between examinations, such as 2 or 3 years, and spread out the examinations if performance over the years justifies it.

To assist in developing consistency in repair procedures, maintenance manuals tailored for your specific buildings can be developed. Comprehensive manuals can include records of identified causes of earlier problems, documentation of as-built conditions observed during any repairs involving removal and replacement, and detailed descriptions of repairs performed including product names, addresses of suppliers, comments on availability, quality, etc.

Your old buildings, if properly maintained, have the potential to out last your new buildings. Old buildings were normally designed and constructed much more conservatively than our new buildings.

Cost Control Centers

Robert A. Getz
Associate Director, Physical Plant
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What is a Cost Control Center?

A Cost Control Center is a measuring device which serves as a means for determining how much an operation or a group of operations actually costs. It provides executives and managers with the means of comparing one operation with another.

Although most likely not identified as such, Cost Control Centers exist at all educational institutions. The nomenclature is not important; the importance lies in the utilization of the concept to enhance and improve the institutions.

A measuring device of this nature provides a systematic control over a service or operation. Such control is accomplished by reducing the various functions to a financial balance sheet. Thus, not only is the operation as a whole measured and controlled, but each individual function may also be included. The degree of monitoring and control is dependent upon the requirements of the individual manager or executive.

A side effect in this age of "Management by Objectives" is the ease with which these Cost Control Centers may be related to a specific MBO. By definition, MBO's are measurements of success, while Cost Control Centers are measuring devices. Thus, they may be linked directly to an objective to illustrate the desired improvement.

Why Should Cost Control Centers be Established?

The first incentive for establishing Cost Control Centers is their capability to self-destruct. Cost Control Centers do not self-perpetuate after becoming unnecessary or inefficient. Everyone has seen a service which is neither utilized nor required, yet continues to operate simply because it is funded. Such wastefulness is not possible with a properly established Cost Control Center, since it must be eliminated as it outlives its usefulness. Since it is not funded, but relies upon customer needs and satisfaction, it self-destructs once those needs are no longer satisfied and the customer no longer provides funding.

On the other hand, the customer provides the funding for the additional development and expansion of successful services. Even if a manager is in the position of being unable to accumulate funds, a successful Cost Control Center will provide the necessary justification for fund requests to develop or expand services. Thus, these Centers are modeled upon the classical "Supply and Demand" theory of economic society.

In addition, Cost Control Centers pinpoint those instances where there is a failure to meet budgetary goals. They provide the manager with a network of the service, highlighting along the way each point of cost and revenue. Thus, the highest return will be provided by directing intuitive managers to the critical points of service where corrective measures will have the most telling success or enhancement of services. Not only are the costs and revenue pinpointed, but this network also provides for overall control of a service and allows a manager the opportunity to focus upon an individual element of an operation. The aim is not to merely concentrate upon corrective measures, but to also study and learn from the successful points within an operation.

Where are Cost Control Centers Established?

Cost Control Centers may be established as an adjunct to any existing service or operation. This "how" is limited only by the imagination. Since the Centers are basically accounting functions, the most logical point at which to locate them is at the focal point of the monetary transactions within the unit. However, a manager may wish to locate his or her Centers within the service or operation being monitored, in order to create the most immediate impact. This alternative will force those responsible for day-to-day operations to closely monitor the cash flow and to arrange for immediate corrective action upon demand.

Service-oriented functions benefit a great deal from the implementation of Cost Control Centers. They are normally customer-oriented and are easily measured in terms of exceeding or falling short of budgetary goals. Thus, the orientation of these Centers to "supply and demand" and self-destruction are tailor-made to a service which relies upon consumer needs and satisfaction.

Newly established operations and services should also be targeted as potential Cost Control Centers. The ability to monitor the entire operational network or to focus upon individual components should be considered a necessity as new services or operations are offered. In terms of dollars and cents, the Center will determine whether or not new services and operations fulfill customer needs at a competitive cost.

Thus, Cost Control Centers may be established in those areas where comparisons are desired with comparable resources. The cost of providing refuse removal with internal forces or outside contractors, the utilization of staff or student employees, or the determination of the capacity of equipment to be purchased are only a few examples of the use of the measuring device in comparison decisions.

How Are Cost Control Centers Established?

The requirements of the operation or service must be determined and established. How often is the normal standard of service to be provided? The requirements could be based upon a reaction to emergencies, the movement of people or material according to a time schedule, or upon a quantitative figure. They could also be a combination of those standards or a series, in which each standard is the result or continuation of the one previous.

The means of developing the costs at each point throughout the network must be determined. All costs must be funnelled through these collection points in order to provide an accurate determination of budgetary goals. Thus, all sources of revenue must be determined and processed via these windows. The identification of the proper points at which to credit the revenue is critical, as it is the base for all future calculations and determinations of efficiency.

Finally, the measuring devices must be established. Is an industry standard to be utilized or must the device be based upon something unique to the manager's organization and structure? That decision must be accomplished on an individual basis as the Centers must be developed to quantify the decisions for the individual organization. The organization itself will be the sole determining factor for establishing measuring devices.

Who is Responsible for Cost Control Centers?

The final question relates to division of responsibility. Should the Centers be placed as high or as low as possible within our institutional organizations? Before answering, think about those management articles you've had an opportunity to read in the last couple of years. Have they been "pushing responsibility up or down"? They've been aiming at establishing an entrepreneur spirit at the lowest possible level, which is where responsibility for these Cost Control Centers should be established. Give supervisors and managers an opportunity to "strut". Allow them the commensurate responsibility and authority to control these Centers.

In conjunction with assigning responsibility, ensure that those responsible are properly supported. This is of special concern when dealing with staff. Those managers must be supported, not hindered by the various staff levels. All too often, staff members have a tendency to be limited by their specialty and outlook. Being unaware of overall operational needs, they stifle the managers and supervisors. Those who are assigned responsibility for the Centers must be nurtured and guided toward their goals. They must be allowed to both succeed and err so that they may learn from their experiences of discovery and correction. This is, after all, the training ground for future executive replacements.

MANAGING NON-HVAC ROUTINE MAINTENANCE

Paul Biggers
Supervisor, Facilities Inspection and Maintenance
The George Washington University

As college and University campuses become more complex, and more and more money is required to provide the facilities needed to attract top flight students and faculty, how can Physical Plant Departments keep up?

One way could be that more men are hired and specifically trained to take care of new requirements. However we all know that usually the money isn't available to do this.The typical scenario at most campuses is that any extra money is usually earmarked for upgrading the instructional and living areas. Actually this is the way it should be, because our livlihood depends on our institutions being able to attract the best and brightest of students and personnel. So what is the answer, how can we as maintenance people do more with less. GW faced this dilemma, we needed a new direction if we were going to keep up. Evidence shows we have succeeded.

7 or 8 years ago the G.W. Physical Plant began implementing a set of programs that would ultimately become known as The Facilities Inspection and Maintenance Programs or FIMP, and although the success or failure of Physical Plant departments is hard to ascertain, and frequently must be based on empirical evidence we do have indications that these programs have been successful and have helped us to meet the changing needs of the University, without placing undo strain on the University`s budget. From fiscal year 78 until fiscal year 84 our maintenance staff has decreased from 72 people to 62, and the Director of Housing, Ann Webster, says the residence halls are in the best shape ever. Our floor area requiring maintenance has increased by about 1.3 million square feet in those years, and our payroll has decreased 1/4 million in 1978 dollars (see graphs 1,2&3). Graph one shows the relations of our labor costs compared with what they would be if they had risen with the cost of living and also shows that our contracting costs have remained fairly level. Graph two shows our labor costs peaking in `82 and that average square footage per employee continued to rise, again the contract costs remained the same. Graph 3 shows that our personnel declined from 72 to 62 and the square footage per employee increased from 40,000 to 64,000,

again contract costs were level. If prevention of a deferred maintenance list is a criteria for a successful physical plant department, our's is a success. No critical maintenance has been deferred for lack of resources recently at G.W; for example our engineering building, Tompkins Hall, will soon need a roof, but we have known about it, and have time to budget for the project. So, add it up, we have over 5 million square feet on sixteen downtown city blocks, with sophisticated maintenance requirements unimagined even ten years ago, being maintained by fewer men, little or no deferred maintenance, and our customers, the users, are happier now than ever.

How do we know the actual users of our facilities are more satisfied? Basically, because the phone doesn't ring off the hook like it did at one time. Our managers very rarely receive irate calls anymore because the huge majority of work is done in a timely fashion, and much is done before a user would even notice that something needed to be done. Also, even though we are maintaining more area with fewer people, our emergency and minor ticket repair calls haven't increased.

We have achieved this by using our FIMP programs but G.W. considered many alternatives before finding a method that helped us get the maintenance done that had to be done. Computers seemed at first to be a way of helping us, but we quickly found that we did not have the necessary data base to really determine what maintenance was needed. Although computers may have helped with keeping track of what had been done, a method was needed to provide direction. We considered a possible reduction in over-all maintenance; accepting the fact that we would not get to everything, but this wasn't an answer because lowered maintenance requirements lead into a downward spiral that doesn't bottom out, as the campus gets larger, and more complicated. G.W. also thought about doing only what had to be done and skipping the rest; by using this approach we would be able to maintain essential systems, this method would keep the campus operating but invariably the areas where maintenance levels are reduced are the areas that prospective students and faculty see first, and first impressions are essential for a University. We also considered planning some maintenance and fire fighting the rest, but doing maintenance this way means some campus users learn the system and get all their work done while other users (with less savy or political acumen) get almost no work done. For all the reasons above our managers decided there had to be a better way, and we found the better way was actually the old ways we had drifted away from.

The major areas of our improvement resulted from very minor changes and constant positive reinforcement of age old procedures. Primarily inspections, of all shapes and sizes. Any Physical Plant must constantly inspect everything; don't hire inspectors, use your available personnel and you are much better off. A carpenter or locksmith knows much more about maintenance and repair requirements of door hardware than a manager normally would, and a building manager would know more than a user. One particular inspection GW has had considerable success with is our regular houskeeping inspections.

These inspections, conducted by Physical Plant personnel accompanied by housekeeping foreman and building occupants are designed to spot flaws in our housekeeping routines, but ultimately accomplish much more. The most obvious result is a cleaner neater building, but in addition regular inspections show the flag so to speak, by getting physical plant people, housekeeping personnel, and building occupants dealing one on one resulting in better rapport, and better understanding of problems associated with maintenance. Housekeeping inspections are not administered by FIMP but are essential to its success due to the ease of spotting maintenance requirements when a building is well cleaned and occupants become accustomed to dealing with Physical Plant personnel.After rediscovering the correct methods of maintenance, how can they be organized to get the job done.

We began by determining goals. The goal for maintaining life safety equipment was easy, any condition other than 100% was not acceptable. Also with comparatively reduced financial resources we could not afford any emergency work which may have to be deferred; the method chosen would have to allow for an early warning of developing problems. Any system chosen needed to allow for tight scheduling of manpower, and for rapid movement of our labor force to concentrate in specific areas, because the window of time availability in some buildings is often quite narrow. Another requirement was the need to be able to combine usage and visibility in a coherent system; invariably some areas are heavily used and few people see them (kitchens), while some areas are not used hard but everyone sees them (elevator lobbies).

With these constraints and objectives, we were able to begin. G.W. Physical Plant Department decided that to have any chance of keeping up with maintenance requirements, the place to start would be a meeting of minds to determine necessities. As mentioned before maintenance levels for life safety equipment is easy to determine; sprinklers, fire alarms, fire door components, smoke and heat detectors, regular and emergency electrical systems etc. must be kept in new condition. Other building components need greater or smaller amounts of attention. Determining the correct level of maintenance for any system required a complete inventory, research into recommendations from manufacturers, estimates of manhours required, and many educated judgement calls. As each maintenance need was worked through on each system, all similar campus systems were inventoried, any unique requirements considered and then combined into a single program for scheduling purposes. There are now 24 such programs in the FIMP system (see attachment 1). This system of integrated programs provides management with historical files on each building. As data is accumulated in each program file on each building it becomes much easier to assess needs and pinpoint areas where problems are developing. Deferred maintenance is thus avoided and man-power is easily adjusted to accurately reflect current needs.

FIMP was implemented orginally by drawing together existing programs primarily for centralization. Early programs - essentially inspections and maintenance of life safety equipment - were central to the total program and formed its backbone.One of the earliest programs was the inspections of roofs. Let me regress for a moment here and point out that our policy of using primarily in-house personnel for our programs was deviated from in the area of roofs. For our roof inspections we have recruited outside personnel. It is absolutely essential that roofs be well maintained. GW inspects each roof twice a year, and now has an inspector who can perform minor repairs on the spot, knows roofing procedures intimately, and can adequately supervise outside contractors to ensure quality workmanship. The primary reason I'm emphasizing roofs is that in orignating our maintenance programs and in the process of organizing our management system for routine maintenance, it was clear that a water tight building envelope was essential. It quickly became evident to us, and will to anyone who wants to establish a system similar to ours, that there cannot be too much redundancy in roof inspections. We feel comfortable with our various roof inspections which include non-destructive tests with a nuclear device and infa-red spot checks, regular core samples of roofing membranes and twice a year thorough visual checks. It is essential to remember that it takes only a few weeks for a roof to go from being maintainable to requiring total replacement.

Later other programs were added as required. It was remarkably easy to identify areas requiring routine maintenance. Most programs derive from user needs or complaints. Other programs are designed to meet specific needs, such as sprinklers, for insurance requirements. As a need for a particular program became evident, we calculated frequency, took inventories of similar systems, and determined manpower requirements. Checklists were developed to control each program, using industry standards and past experience. Each program and its controlling documents was designed for flexibility to meet PPD, user, and University needs, because often these needs may be different. For example, manufacturers recommend that emergency diesel power systems should not be started and run without load, but to assure the users, (who may need these generators) that they will start when needed, we start them once a week anyway; and then once a month do our full load test.

As mentioned, programs are established to answer specific needs, and to respond to customer concerns. A third reason programs have been established is for Physical Plant convenience. An example of this type program is our maintenance program in kitchens. It would be easier for the Physical Plant to let the users of kitchens be responsible for maintenance (they are the experts); but it is much more effecient for us to schedule the maintenance routinely. Otherwise craftsmen would be responding to calls and repairing one item at a time.

As these programs were developed, GW divided them into three categories:

I Inspections are programs that are used to define and identify breakdowns in major systems such as roofs or structural envelopes, or to look for particular items, such as asbestos during remodeling projects. When a needed repair is identified, a job order is written and prioritized. These repairs, controlled by the job order, are either done according to priority or forwarded to appropriate authorities for funding.

II PM programs are also inspections, but with predetermined maintenance and benchmark tests included. The maintenance and tests needed for a particular system are defined and controlled by checklists, and any problems discovered are usually corrected as emergencies.

III Find/Fix are programs that use scheduled teams of craftsman to systematically inspect for and then perform contingency maintenance on a particular system or in a complete building. During a Find/Fix procedure virtually any problem discovered is repaired immediately.

In each of these categories the individual programs are broad in scope yet detailed in application. Two examples of programs are Program 31, preventive maintenance of major switchgear, and Program 70, find/fix interiors.

Maintenance of major switchgear is critical for the usefulness of a building for obvious reasons. But how does a physical plant department ensure that all switchgear components are in design ranges when the work must be done by specialty contractors that a plant is not fimilar with? To manage this type of program plant personnel must have complete inventories of all equipment in a particular building (example attachment 2), and a complete set of specifications (attachment 3). These specifications are available from many different sources; compare our specifications with the District of Columbia's requirements (attachment 4). After the Physical Plant does the best it possibly can to provide accurate guidelines insist on full reports listing the test results on each piece of switchgear equipment. This report of test results should also list requirements for futher maintenance and will be the only control Physical Plant has over work performance and should be reviewed closely before payment is made.

The other example is Program 70 of our find/fix series, the cornerstone of GW`s maintenance. Program 70 uses more than half of our routinely scheduled man hours, controls the interior maintenance of our buildings, and is used as our primary tool in preventing the deterioration of classrooms, dorm rooms, offices and public spaces inside the 78 buildings PPD maintains.

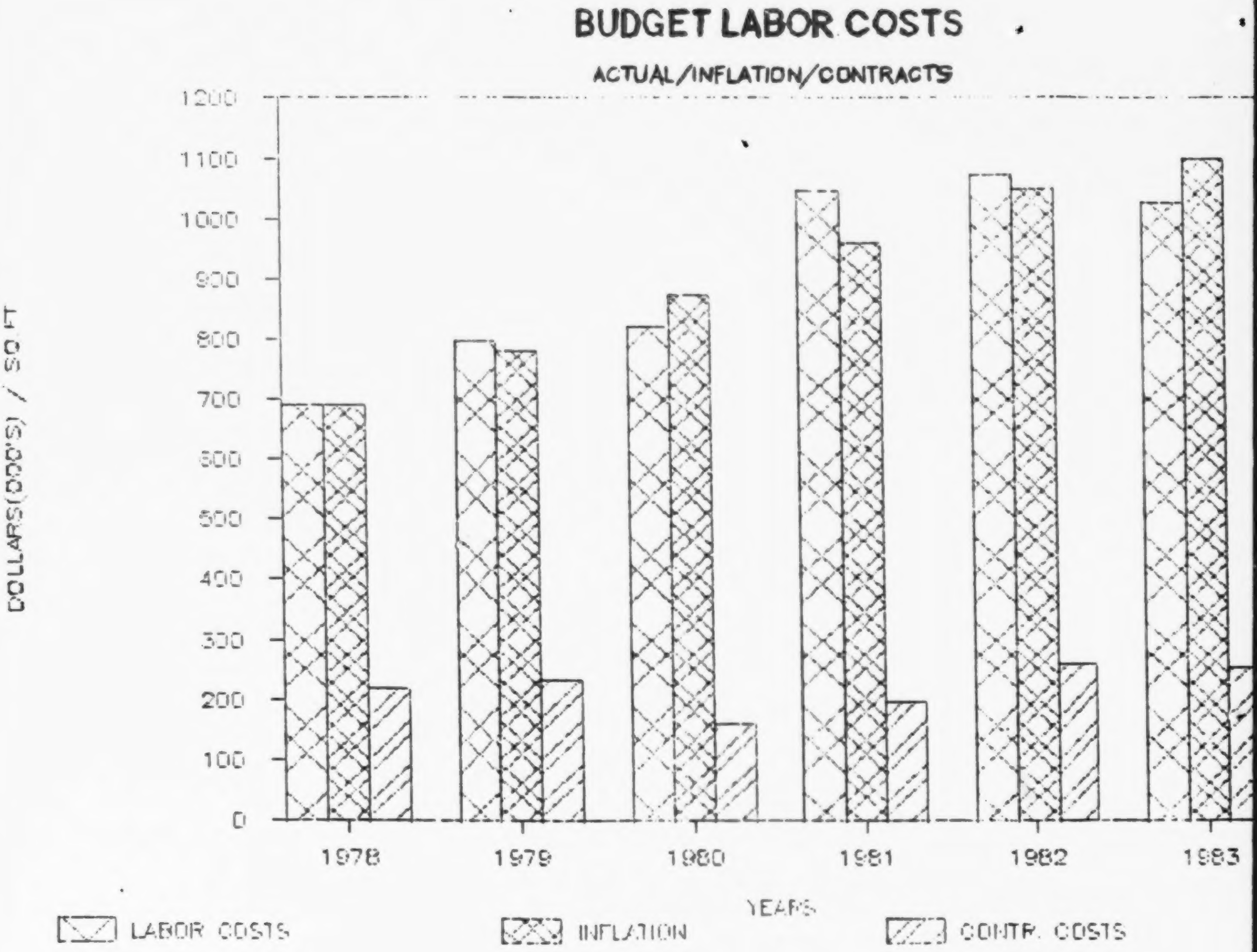
GW had been maintaining building interiors by inspections, followed by writing specific job orders. This method focused our maintenance on necessary areas, but the inspector's costs, long lead time, and paperwork needed for this process became unacceptable. Program 70 enables GW to employ our craftsmen to find the repairs needed and fix them on the spot.

Program 70 find/fix was set up by GW to insure that large costly repairs would not result from unnoticed small repairs. The idea behind find/fix is similar to how a homeowner would do maintenance, that is by being always observant and making small repairs as needed, or insuring that someone else makes them, and has been used for years, especially by the military. However, even though this was an old idea, it`s implementation on a campus-wide scale with large crews was difficult and time-consuming, requiring much supervision and training. Inventories of materials needed, calculations of crew sizes, average production in square footage per man hour, and availabililty of buildings had to be worked into the schedule, complexity of buildings (i.e. differences between labs and lecture rooms) was determined, and all these separate elements were combined to make a workable program. After program 70 was documented and scheduled, check-lists that included each item thought to need regular attention, were designed to direct each craft. A copy of each of the controlling documents is included (attachment 5,6,7,8,9).

Program 70 has been used for five years, and the scheduling and management benefits of Program 70 enabled GW's PPD to repair or identify every defect in our 12 resident halls between the middle of May and the end of July in 1984. The Associate Director of Housing and Resident Life, Dave McElveen, said that he feels our residence halls are in the best shape ever and compare favorably with any campus on the east coast judged by his observances, including campuses with considerable new student housing. The managers at our library, student center and major campus academic buildings also agree that there has been a significant improvement in our campus enviroment. I'm sure many assume that we at GW have made a huge investment to accomplish this level of maintenance. We didn't though.

As I said before our maintenance staff has gone down and we have added one position, mine, to coordinate and manage these programs. The keys to successful maintenance are: go back to the basics such as find/fix and inspections and forget the computers until your programs are in place and well integrated, inspect to the point of redundancy and if at all possible make repairs immediately on the spot. We in maintenance work only a razors edge from catastrophe; as mentioned before it takes only a short while for a servicable roof to become completely saturated and then that roof can only be removed, so we at GW are always watching and sometime obnoxious on occasion about these responsibilities. And finaly GW has found that it is essential that we stick to our knitting. The book "In Search of Excellence" stated that one of the reasons well run companies stay on top for so long is that they stick to what they do well. For Physical Plant Departments that means sticking primarily to maintenance. We found we weren't successful as a general contractor to the campus, so we use remodeling work to fill-in the low points and contractors to chop off the high points, and stick to maintenance. FIMP has allowed GW's Physical Plant Department to routinely schedule about 50% of our available man-hours and to find and direct another 30% ourselves through inspections, but we also know, because of the scheduling benefits of FIMP, when the other 20% can be used which allows us to plan almost year round. FIMP works at GW because of its planning and because it has the support of top management, it couldn't work the way it does without that support. So, in conclusion, FIMP took lots of plannning and lots of support from the top to make it work but it does work.

GRAPH I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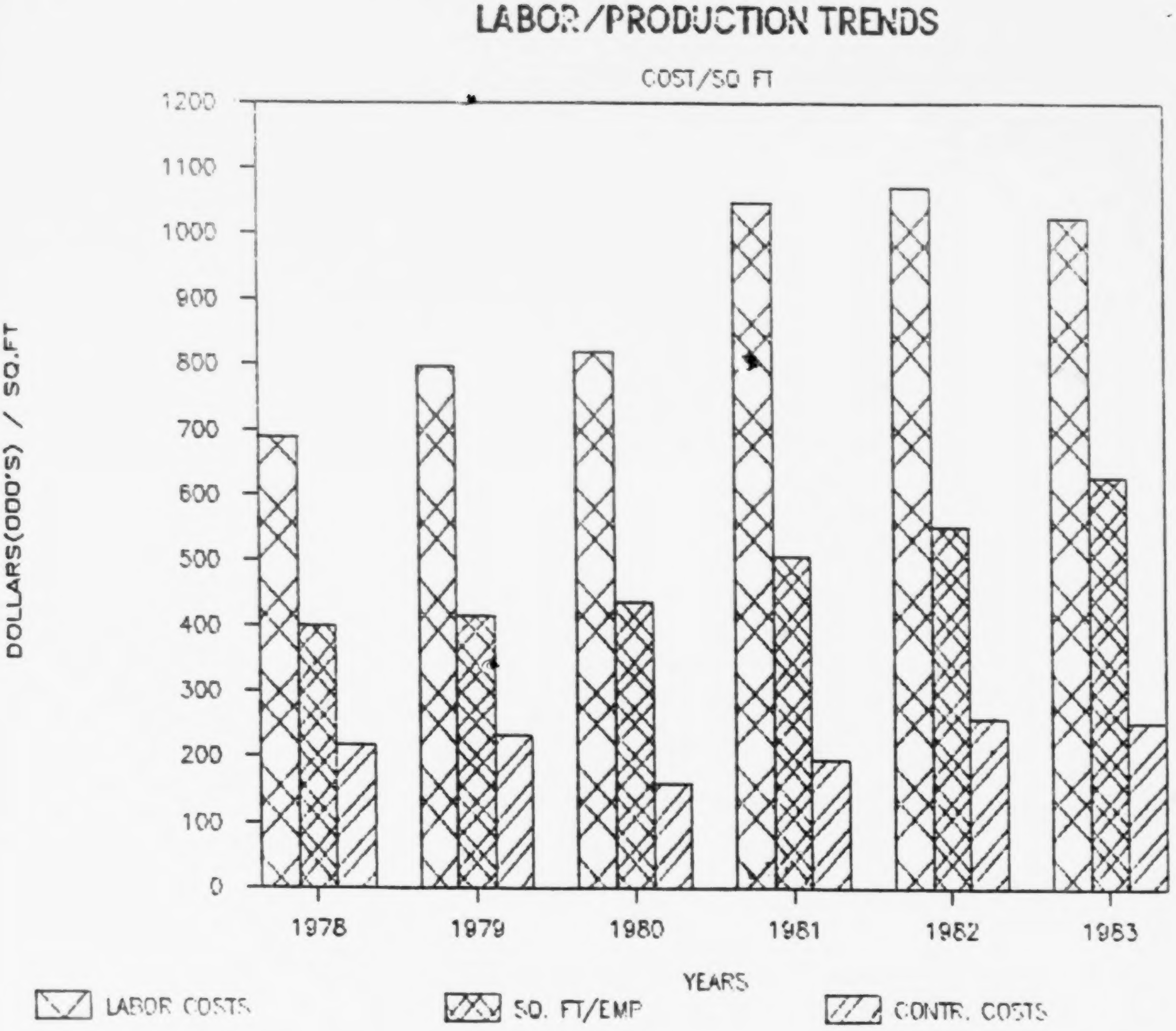
1000
900
800
700
600
500
400
300
200
100
0
1978
1979
1980
1981
1982
1983
YEARS
LABOR COSTS
INFLATION
CONTR. COSTS

GRAPH 2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100
200
300
400
500
600
700
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900
1000
1100
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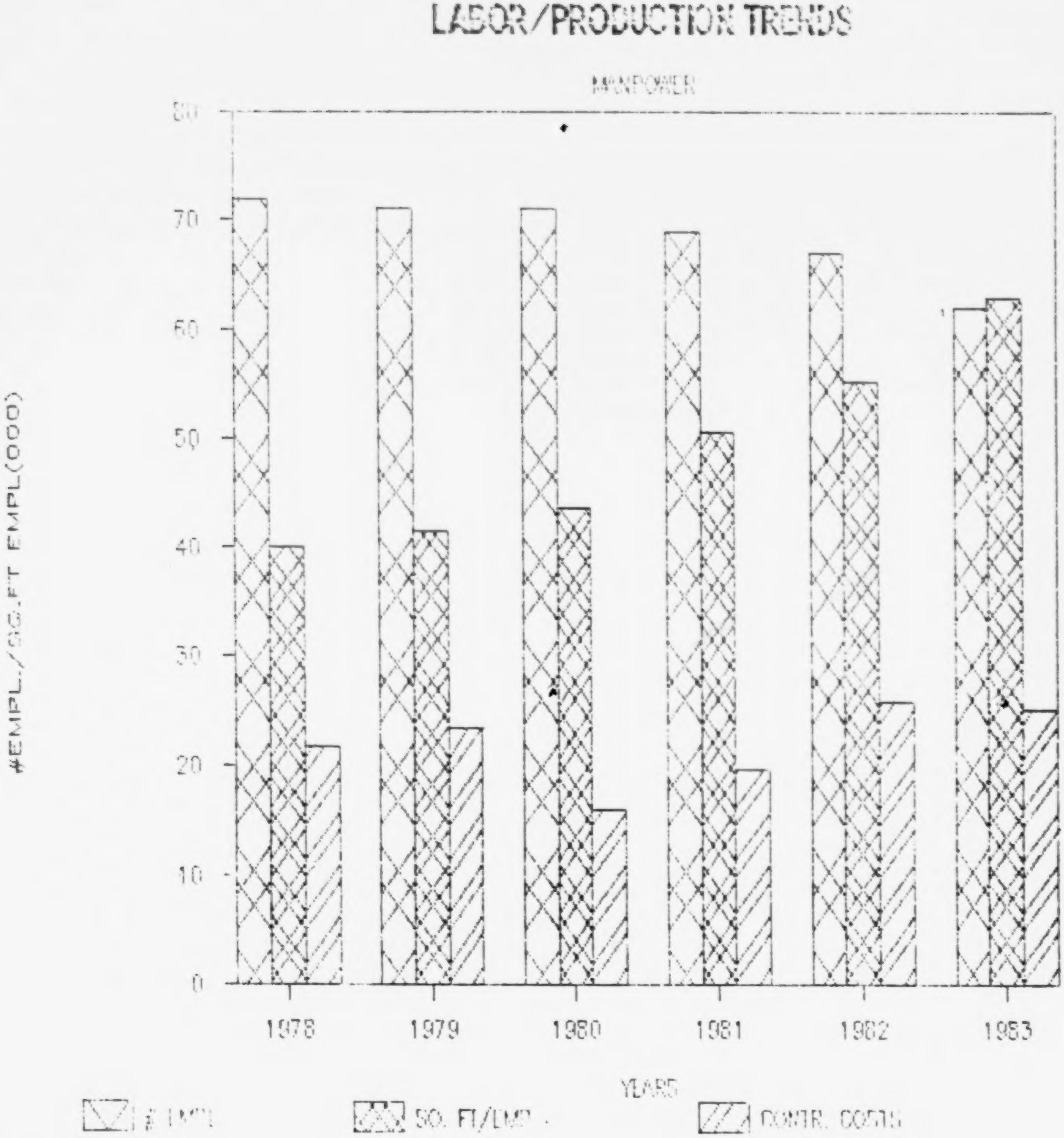
1979
1980
1981
1982
1983
YEARS
LABOR COSTS
SQ. FT/EMP
CONTR. COSTS

GRAPH 3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70
60
50
40
30
20
10
0
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1979
1980
1981
1982
1983
YEARS
# EMPL
SQ. FT/EMPL
CONTR. COSTS

ATTACHMENT 1
List of FIMP Programs

FACILITIES INSPECTION AND MAINTENANCE PROGRAMS

10. Envelopes - Once each year, a complete structural envelope inspection using a check list and a set of instructions is done by Building Managers and coordinated by the structural inspector.

11. Roof - Is a complete roof inspection, done on each building each year. Inspections are done by a roof inspector, with pricing done on forms ready to submit to appropriate people for approval.

12. Moisture Meter - Non destructive tests are done on each major flat roof every other year. The tests are performed to establish benchmark data and to pinpoint problem areas before breakdowns.

14. Sprinkler Inspections are done once each quarter with in-house personnel. Complete checks of flow and tamper switches, alarms, etc. are done. The problems found are reported and usually done on an emergency basis.

15. Asbestos Inspections are done at each renovation project and as possible asbestos is discovered. All samples of any friable materials are tested - done in-house, if friables are asbestos appropriate action is taken on an emergency basis.

30. Re-lamps are done on a case by case basis, in-house, as money is available.

31. Switch Boards are done every three years on twenty systems over 1000 AMPS by contract personnel, and controlled by PPD documents.

32. Motor Control Centers - Fourteen motor control centers have contacts and heat sensors tested and maintained every three years by contract personnel controlled by PPD documents.

34. Emergency Generators - Diesels have all gauges checked and all connections, batteries and fluids checked once a week. Complete operational check is done once a month on the total system of eight generators under load. The work is done by in-house personnel, and controlled by check lists.

35. Emergency Generators - Eight gasoline generators complete system checks are done once each week. The work is controlled by a check-list and done in-house.

36. Emergency Battery Packs - Four systems are tested and checked for voltage and specific gravity once a month by in-house forces, controlled by check-lists.

FACILITIES INSPECTION AND MAINTENANCE PROGRAMS CONT'

38. Trash Chutes - Each trash chute is tested and repaired as necessary once a quarter by in-house forces using a check list.

39. Fire Alarm Systems - Forty-eight fire alarm systems are tested and repaired once a year, by activating each station and monitoring alarms, bells, and panels. Repairs are done as follow-ups on an emergency basis. This work is done by in-house forces controlled by PPD documents.

40. Elevators - Elevators are maintained routinely, on a weekly, by-weekly, or monthly basis determined by machine needs. The work is done by contract personnel controlled by PPD documents and specifications, and managed by in-house personnel.

41. Burglar Alarm Systems - Six burglar alarm systems are tested once a month by in-house personnel.

45. Sprinkler Systems - Preventive maintenance is done once a month on 20 wet systems, once a month on four water motor gongs, and once a week (twice a week in freezing weather) on ten dry systems by in-house personnel controlled by check-lists.

50. Painting - Painting is done in Ross Hall on a recurring five year basis.

70. Find-Fix Building Interiors - 48 academic and administrative buildings are inspected and repaired twice a year, and 12 dormitories once a year by in-house crews, directed and controlled by check lists.

71. Find-Fix on Eye Washes and Safety Showers - 200 eye washes and safety showers are inspected for pressure and water volume twice a year by in-house personnel, directed by check-lists.

72. Kitchen Find-Fix - Six kitchens are inspected and repaired bi-weekly by in-house crews directed by check-lists.

75. Lighting Suppression Systems - Eight systems are inspected for ground and continuity, by in-house personnel once a year.

76. Residence Hall Fire Alarms - Twelve dormitories have fire alarm systems inspected and repaired once a month by in-house personnel, directed by check-lists.

77. Asbestos Find-Fix - All areas where friables have been identified as asbestos are inspected once each year for integrity of encapsulation, and repaired immediately if necessary.

78. Acid Tank Find-Fix - Twenty-six acid neutralizing tanks are inspected and repaired twice each year by in-house personnel directed by check-lists.

ATTACHMENT 2
Sample of inventory of switchgear

University Parking Garage - 2211 H Street

1	Incoming service 3000 amp 120/208 volts 3 phase
1	2000 amp 30 circuit breaker Westinghouse #PB3200F
1	200 amp 30 circuit breaker ITE #C13M200
1	100 amp 30 circuit breaker Westinghouse #FB3-100PL
1	750 KVA Transformer 208 TO 265/460-30 Heavy-duty Electric
1	35 amp 30 circuit breaker Westinghouse #HFB3035
3	50 amp 30 circuit breaker Westinghouse #HFB3050
2	125 amp 30 circuit breaker Westinghouse #HFB3035
2	174 amp 30 circuit breaker Westinghouse #LAB3125W
1	200 amp 30 circuit breaker Westinghouse #LAB3200W

Emergency System

1	Fire alarm fuse box
1	30 KVA transformer 208 to 277/480 Sorgel
1	60 amp 30 fused safety switch Westinghouse #HF-462N
1	Panel - marked EW - 277/480 volt 100 amp Westinghouse

ATTACHMENT 3 - GW requirements on switchgear testing

General Requirements

1 This specification covers inspecting, cleaning, and testing of all equipment listed on inventory sheets. All work to meet D.C. Code Article 384 "Preventive Maintenance".

2 The contractor will obtain all necessary permits from the D.C. Department of Permits and Inspections prior to proceeding with work. Permit shall be on job site at time of work. A copy of permit shall be inculded in final report.

3 The contractor shall send the D.C. Department of Permit and Inspections a verification of compliance on all buildings serviced and provide a copy of the letter of compliance in final report.

4 All preventive maintenance work will be performed on a predetermined date and time by George Washington University.

5 All on site work will be supervised by a George Washington University representative.

6 After all preventive maintenance work is completed, reports shall be issued promptly to George Washington University. These reports are to include: A) copy of D.C. permit; B) copy of verification of compliance, C) summary of all findings and corrective work; D) recommendations of further repairs and/or maintenance work that should be scheduled; E) complete documentation of all test and inspections results. Test and inspection results must be submitted on each circuit breaker, fused safety switch or unit, each protective relay, and each power transformer.

7 Testing shall be done in accordance with the manufacturer's instructions, these specifications and applicable NEMA, ASA, ANSI, NFPA, and ASTM standards.

8 The contractor will be responsible for having power company de-energize equipment where necessary and have power company bill George Washington University direct.

9 The contractor will provide all necessary qualified personnel (DC electrical journeyman's license), tools, test equipment, temporary power, and safety equipment necessary to complete work described. Helper or apprentices may be used in cleaning of equipment.

10 Any minor corrective maintenance work and adjustments that are required to restore the designated equipment back to proper operating condition shall be done during scheduled outage.

11 Quote shall include all overtime required to complete work on other than normal work hours and/or holidays.

12 Final payment will be after compliance with paragraph #3.

Switchgear

1) Inspect for physical damage.

2) Inspect for proper grounding and size of service ground. Record and report to George Washington University.

3) Inspect for any unusual conditions, moisture, excessive dust, debris, rust, etc.

4) Check tightness of all bolted electrical joints by calibrate torque wrench method. Refer to manufacturers recommendations for foot pound levels or other applicable standards.

5) Measure insulation resistance of each buss section phase to phase and phase to ground for one minute at 1000 volts record and report findings to George Washington University.

6) Clean entire switchgear inside and out.

Transformers

1) Inspect for physical damage.

2) Check for proper disconnection mean and overcurrent protection.

3) Check tightness of all bolted electrical joints.

4) Insulation resistance test shall be performed winding to winding and winding to ground for one minute at 1000 volts record and report to George Washington University.

5) Winding resistance test shall be made for each winding. Record and report to George Washington University.

6) Check for proper grounding per NEC.

7) Clean interior and exterior.

Circuit Breakers

1) Inspect for physical damage.

2) Check mechanical operation

3) Check case for cracks or other defects.

4) Check tightness of all electrical connections.

5) Perform contact resistance test (Micro-ohms-ductor). Record and report to George Washington University.

6) Time current charcteristics test shall be performed passing three hundred percent rated current through each pole. Record and report trip time to George Washington University.

7) Instantaneous pick-up current shall be determined by run-up or pulse method. Clearing time should be within four cycles or less. Record and report to George Washington University.

8) Time current characteristics test and instantaneous pick-up current test shall be done on all 100 amp and larger branch circuit breakers and on all distribution circuit breakers.

9) Clean inside and outside of enclosures.

Disconnect Switches, Fuse and Switch Units and Transfer Switches

1) Inspect for freedom of movement and friction of actuating parts.

2) Inspect for discoloration and other signs of overheating.

3) Inspect for loose, broken or missing parts.

4) Clean contact surfaces where accessable.

5) Check contact pressure, wipe and drag of surfaces.

6) Perform contact resistance test (micro-ohms-ductor). Record and report to George Washington University.

7) Fuse and switch units perform contact resistance test from connecting buss to line side of fuse holder with switch closed. Record and report to George Washington University.

8) Clean interior and exterior.

Cables

1) Inspect for physical damage.

2) Cable connections shall be torque tested to manufacturer's recommended values.

3) Perform insulation resistance test on each cable and/or phase with respect to ground and adjacent cables or phases.

4) Insulation resistance test shall be performed at 1000 volts for ½ minute.

Grounding

1) Inspect for physical damage.

2) Check tightness of all electrical joints..

3) Check service ground system. Record size and report any deficiencies.

ATTACHMENT 4 - District of Columbia requirements for switchgear testing

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

NOTICE TO OWNERS OF A SWITCHBOARD HAVING A CAPACITY OF 1000 AMPERES OR LARGER

The Building and Zoning Regulation Administration of the Department of Housing and Community Development directs the attention of owners of a switchboard having a capacity of 1000 amperes or larger to Section 384-33 of Article 384-D, Preventive Maintenance, of D.C. Law 2-17, the 1977 Electrical Code, as follows:

"Section 384-33 Switchboards of 1000 or Larger

> It shall be the responsibility of the owner of a switchboard having capacity of 1000 amperes or larger, or his responsible agent, to have a licensed master electrician disconnect said equipment once every three years or less to perform prescribed preventive maintenance. Preventive maintenance shall consist of, but not be limited to:
>
> (a) Vacuum entire interior of switchboard.
> (b) Clean bus and contacts with a suitable nonconductive solvent.
> (c) Lubricate all moving mechanisms.
> (d) Check all conductors for abrasions.
> (e) Torque bus and conductor connections to manufacturers' recommended specifications.
> (f) Check calibration of overcurrent trip units and protective devices.
> (g) Megger board to manufacturers' specifications before re-energizing.
> (h) Replace worn, damaged, or deteriorating components.
> (i) Submit report of preventive maintenance performed to D.C. Electrical Inspection Section within thirty days."

This law must be complied with on or before May 15, 1981. Any person who fails to comply with this requirement shall, upon conviction, be fined not more than three hundred dollars ($300) or imprisoned for not more than ten (10) days.

BEST COPY AVAILABLE

ATTACHMENT 5 - job order directing Program 70 find/fix interiors

THE GEORGE WASHINGTON UNIVERSITY
(PHYSICAL PLANT DEPARTMENT)

JOB ORDER

1. REQUESTING DEPARTMENT		2. DEPARTMENT CODE	3. JOB ORDER NO 4. SHOP CONTROL NO. 5. ESTIMATE NO.
6. ACCOUNT NO.	7.	8.	9. BUILDING NO. OR NAME
10. FOR FURTHER INFORMATION CALL: Building Manager, Ext.			11. SKETCH PLAN ATTACHED ☐ YES ☐ NO
12. GENERAL JOB DESCRIPTION	13. Use Labor Class Code except for overhead		COMMITTED STARTING DATE

1. Reference PPD FIMP Program Instruction "Management of Program 70", April 25,1983.
2. Perform Find/Fix procedures per referenced instruction. Limit work to maintenance/repair i which you estimate will require two man-hours or less to correct and to emergencies. Record a material issued for the work on material requisition slips and deliver a copy to Mr. Suter. .L and describe maintenance/repair items that need to be done but which cannot be done within two man-hours and deliver the list to Mr. Suter.
3. Work Centers 11,12,13,21,22 perform as scheduled below. Other work centers perform as dire by Mr. Suter/Mr. McGinn.

WC	Start	Finish	Days	WC	Start	Finish	Days
11				21			
12				22			
13							

14. BREAKDOWN OF WORK			15. SUMMARY OF ESTIMATES				
a. WORK CENTER	b. DESCRIPTION	c. EST. HOURS	a. WORK CENTER	b. LABOR HOURS	c. LABOR $	d. MAT'L. $	e. TOTAL EST. $
	Perform Program 70 Find/Fix as above.		9				
			10				
			11				
			12				
			13				
			14				
			21				
			22				
			31				
	For continuation see Sheets ______ through ______		32				
			TOTAL				

16. DISTRIBUTION

INSP.	1	MAINT.				f. CONTINGENCY
WRC	25	J. Hart	1			g. OVERHEAD AND/OR SURCHARGE
DP	1	W. McGinn	1	104		h. GRAND TOTAL
BMO		W. Suter	1	17. AUTHORIZED WORK TO BE PERFORMED (Signature)		18. DATE

ATTACHMENT 6 - controlling document for Program 70 find/fix

November 8, 1983

The purpose of program 70 is to maintain the interiors of University buildings in a manner which will enable them to fulfill assigned functions. Accomplishment of this purpose is intended and expected to reduce breakdowns, and interruptions in service to the University.

The scope of program 70 includes repair of everything inside a building which hampers or reduces its operability and usefulness.

Program 70 is accomplished by rotating working crews, on a regular basis, through University buildings. Tradesman identify breakdowns, and using one of three separate procedures, either repair or report breakdowns. The work done, or reported, is coordinated through a lead mechanic who, using a check list examines building components, coordinates work with other shops, and insures either repair or reporting of breakdowns.

The three categories are:

1. If a job is judged by the mechanic to require less than 2 man hours to complete, it is done immediately. The work done is noted on the check list and is noted as being corrected. Any additional follow-up work that is required is reported to the appropriate shop. Material which is used to repair category 1 breakdowns is noted but is not a hindrance to completion of these items.
2. If a breakdown is considered to be dangerous or hazardous to a building or its occupants, and will take more than 2 man hours to complete it is also done immediately, as are jobs in category 1. After the breakdown is repaired the hours and material used is reported in full, and forwarded as an additional cost to the customer.

3. If a breakdown is judged by the mechanic to require more than two man hours and is not considered dangerous, the specifics are noted on the check list and reported as not completed. These jobs are estimated and planned and sent to the customer for approval.

The crews that perform the work consist of carpenters, venitian blind men, plumbers, and electricians. The other shops are called in when work is reported to them through follow-up requested on the check list. Size composition of these crews vary with the size and usage of the buildings. Due to the support nature of some shops the lead mechanic must report to his foreman breakdowns requiring other shops.

Individual Work Center responsibilities:

* Work centers marked by an asterisk generally have little work and what work there is, is usually reported to them by work center 11

Sign Shop * WC 9 will insure that all room signs, exit signs, fire extinguisher signs, and directiona signs are properly fastened, serving the intended purpose, and accurate,

Directories and exterior plaques must be securely fastened and in a complete and undamaged condition. WC 11 lead mechanic will report these descrepancies.

Lock Shop * WC 10 will inspect all locking devices, both corridor and passage for operation and usage. WC 10 will inspect and clean or adjust all panic devices as necessary. Remove and clean all exterior cores. All core numbers and corresponding room numbers must be recorded and matched against main file. WC 11 lead mechanic will report any locking device descrepancies at the close of each work day for follow-up.

Carpentry Shop

WC 11: The carpenters must carry the primary responsibility for program Seventy. WC 11 is the primary shop because they have the task to repair the items which recieve the most usage, specifically doors, windows, cabinets, furniture, floor, and walls.

The carpenters must check all doors and jambs for fit, soundness, and strike and lock adjustment. Door closures must be checked for leaks, action and fastening. In carpeted areas doors must be checked for clearance and trimmed as necessary. Dead bolts, cores and locks should be checked and if repairs are necessary reported to WC 10. Core #'s should be recorded and reported to WC 10 for check against file #.

Windows must be checked for glass and glazing, (if re-puttying is needed on a large scale it should be reported as a follow-up). Screens must be in place on operable windows. Sash guides and weights must be clean and operate freely, and adjusted correctly. Sash locks must be secure and operable. All trim and window stool must be secure and all joints tight or caulked.

All closets should be checked for rod, shelf placement and fastening, and repaired as necessary.

Cabinets (both kitchen and bathroom), dressers, and vanities must be checked for placement, fit and fastening of shelves, doors and drawers. Door and drawer pulls must be in place, and hinges and drawer guides aligned properly and adjusted. Catches must be checked for adjustment and repaired replaced as necessary. Flooring should be inspected and replaced, or repaired as necessary.

Inspection should include a determination (if required) for repairs necessary to correct problem (i.e. is the flooring worn out or is it buckled due to a water leak). Sills and thresh-holds should be checked for tightness and refastened if necessary. Both sills should be caulked, or refastened and caulked, as needed. Walls and ceilings should recieve the same attention as flooring (with particular attention to the 2 man hour time constraint). In each instance the cause of the problem should also be identified and reported.

Paint Shop

WC 12 will have no walk through responsibility. WC 11 and 14 will report all repairs, stains, new trim, caulking or other items needing attention, as only very small areas can be painted in 2 man hours.

Venetian Blind Shop

WC 13 will clean, adjust, and make repaires to blinds, shades, and drapery rods as necessary, up to and including replacement of complete units.

Plaster Shop

WC 14 will follow WC's 11, 13, 21, 22 and make repairs to plaster, ceramic tile, towel bars, soap dishes etc. After WC 14 has finished they will report repairs made to WC 12 for touch-up painting.

Electrical Shop

WC 21 will insure that all receptacles, switches, fixtures and lamps are safe and in good working condition. WC 21 will also clean and calibrate all heat and smoke detectors following procedures established by each manufacturer. Repairs to heat and smoke detectors may include replacement if repairs can not return the unit to full design capability. All common areas including laundry rooms, lounges, lobbies, and hallways, will be treated in the same manner as individual rooms.

Plumbing Shop

WC 22 will inspect for leaks, repair as necessary, and report any water damage to the carpenters, plasterers or painters as necessary. All bath and kitchen fixtures will be inspected and repaired as necessary. Deteriorated toilet seats will be replaced. Clean and recaulk around fixtures as necessary. Water fountains, radiators and wall convectors will be checked and repaired or reported for follow-up as necessary. Common areas will be treated in the same manner, all floor drains should be inspected and cleaned as necessary.

ATTACHMENT 7 - check list for carpenters

PROGRAM 70 F/F CHECK LIST WC 11 BLDG ________________
DATE __/___/___ MECH____________________ JO#_______________

ITEMS	ROOMS							REMARKS BY ROOM #
DOORS ; JAMB, STOP, STRIKE DEADBOLTS, LOCKSETS, SILLS THRESHOLDS, CLOSURES								
WINDOWS; SASHES, SILLS, LOCKS, GUIDES, GLASS, TRIM WEIGHTS, GLAZING, SCREENS								
CABINETS; HINGES, PULLS, GUIDES, COUNTERTOPS CAULKING, SHELVES								
MISC.; CLOSET POLES, MEDICINE CABINETS, TOWEL BARS, SHELVES, FURNITURE								
FLOOR; TILE, CARPET BASE, SHOE, ETC.								
WALLS; CHAIR RAIL, DRYWALL, PLASTER, ETC.								
CEILING; TILE, TRIM, ETC.								
GENERAL MAINTENANCE; HOUSEKEEPING, PAINTING, ETC.								
LIFE SAFETY; ASBESTOS, FIRE EXTINGUISHERS								

MATERIALS AND LOCATIONS USED

ATTACHMENT 8 - Check list for electricians

PROGRAM 70 F/F WC 21 **BLDG.** ______________________ **DATE** ____________ **MECH.** ______

OK = ALL OK; ✓ = PROBLEM REPAIRED (LIST BELOW); X = PROBLEM REPORTED (LIST BELOW BY ROOM)

ITEMS	ROOM #s										
APPLIANCES											
EXTENSION CORDS, PLUGS CONNECTORS											
PORTABLE GANG BOXES											
OFFICE EQUIPMENT											
RECEPTACLE OUTLETS											
WATER & ROOM HEATERS											
PORTABLE & STATIONARY EQUIP., & TOOLS											
LIGHTING, LENS, BULBS SWITCHES											
PANEL, CONTROL OR SWITCHING ROOMS											
HAZARDOUS LOCATION EQUIPMENT											
EMERGENCY EQUIPMENT											

ONCE EACH BLDG., CHECK EXTERIOR LIGHTING, OUTLETS, ETC.

ATTACHMENT 9 - check list for plumbers

PROGRAM 70 F/F WC22 BLDG.________ ____________________ DATE ______________ MECH. ________

OK = ALL OK; √ = PROBLEM REPAIRED (LIST BELOW); X PROBLEM REPORTED (LIST BELOW BY ROOM)

ITEMS	ROOM #s										
TOILETS SEATS, SEALS, TANK, FLUSHING, SLOW DRAIN											
LAVATORIES, VANITIES FAUCET, SEALS, CAULKING, SLOW DRAIN STOPPERS											
URINALS FASTENING, FLUSHING, SLOW DRAIN											
SINKS FAUCETS, STOPPERS, CAULKING, SLOW DRAIN SEALS, STRAINERS,											
BATH TUBS, SHOWERS LEAKS STOPPERS, CAULKING, FAUCETS, CONTROLS, TILE, DRAINS											
RADIATORS LEAKS, CONTROLS											
WATER FOUNTAINS LEAKS, COMP. CLEAN COOLING											
FLOOR DRAINS											
EYE WASH, S. SHOWER LEAKS, CHAINS, ETC.											

MAKING COMPUTER DECISIONS

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It is a rare physical plant that could not use more computer power--for budgeting, preventive maintenance systems, building automation, and so on. And it is a rare physical plant administrator who feels entirely confident when making the decision to spend several thousand dollars for a computer system. The focus of this paper is to provide a basic framework for making computer decisions. While the framework may be applied to any type of computer system, administrative systems will be emphasized. It is also recognized that no two acquisitions are alike; therefore, the framework may need to be modified to fit individual situations.

The basic subjects covered include Self-Education on Computers, Determining Needs, Systems Analysis, Computer Size, Software, Hardware, Purchase Options, Requests for Proposals/Bids, and Implementation Considerations.

Step One: Self-Education on Computers

Many of us feel inadequate when it comes to computers--we didn't have them when we were in school, we don't speak the jargon, etc. Even recent computer science graduates often aren't prepared to make decisions on what an organization needs. Buying a computer can be compared to buying a car--you don't need to know exactly how it works, but you do need to know enough not to get "snowed" by the salesperson. You will need to know some basic terms (front vs. rear wheel drive, megabytes vs. kilobytes), some basic components (steelbelted vs. radial tires, disk drive vs. tape drive), and, more importantly, what you want your computer to do.

There are many ways of acquiring a basic computer knowledge. Campus media resource centers have film libraries, college level or adult education courses are offered, bookstores have many computer books for "amateurs", and university data processing staff are willing to provide information.

Beyond a basic knowledge, computer decisions require only a common sense approach to problem solving.

Step Two: Determining System Needs

Before becoming enmeshed in studying systems and vendors, the goals of the system should be specifically stated in terms of the problem you are trying to solve or the improvements that need to be made. These will generally fall into five categories:

1. Reducing workload, eliminating repetitive tasks.
2. Reduce cost--of manual systems, current data processing costs.
3. Better information--more accurate data, more specific data.
4. More current information--timely data.
5. More output from current organizational resources.

At this point, ask yourself if a computer will solve the problem, or if the problem is really rooted in the organization, procedures, staff, forms, current hardware or software systems, or a combination of those. These problems should be solved before computerizing the system.

Acquisitions should be need-driven, but acquiring a computer will develop an insatiable demand in your staff for more computerization as they realize how much computers can help them do their work. Be sure to plan for expanding beyond the immediate needs.

Step Three: Systems Analysis

At this point a basic analysis of your current system should be performed to determine the specific requirements. The information obtained provides a base for writing requests for proposals and system documentation. The analysis can be divided into two activities--studying the present system and determining requirements for the proposed system.

Studying the Present System. Review and document how the process is being handled now within your organization. List the basic functions being performed, the flow of information, data content, equipment utilized, and problems in the system. This step is to ensure an understanding of the present situation; do not become mired in recording everything in minute detail.

Determining Requirements for the Proposed System. Expand the current system to include desired features and data items. The end result should be a document that outlines:

1. The functions of the system. This should clearly define the scope of the project. (Is it going to handle preventive maintenance only, or is it going to be a complete maintenance management system?)
2. The data items required.
3. The size of the data base, including number of records and number of files.
4. Number and type of people using the system (clerical staff, engineering staff). How many need to use the system simultaneously?
5. Basic reports needed from the system.
6. Access time factors.
7. Interface requirements with other computer systems at your

institution. Be critical in determining requirements and consider all options, such as data communications, tape file transfers, on-line access, etc.

An important step in this phase is to clearly communicate the intent of this project to your staff. Work to eliminate their fears and gain their support and assistance.

By this time, you will have felt the need for a systems analyst. There are three basic options; your organizational situation will determine which option you choose. A consultant could be hired to assist you through the process. A new staff person could be hired. Or a current staff member could be assigned the responsibility to coordinate systems development. This option provides you with a person already familiar with your organization. The literature advises managers to select someone with the ability to communicate, a basic business/organizational knowledge, skill in problem-solving, and the ability to learn about computers. Various authors also warn that if an existing staff member is chosen, they should be relieved of enough other responsibilities to allow them to spend "quality time" on this important project.

When the system requirements are documented, it would be wise to visit other institutions similar to yours which have computerized similar systems. This will give you ideas, expand your imagination, start pointing you towards vendors, and hopefully prevent you from repeating some mistakes made by others. APPA can help you find institutions to contact.

Step Four: Size of Computer Needed

There are three basic categories of computers--microcomputer, minicomputer and mainframe. The best choice for your physical plant will depend on the size and volume of your application, the on-line access required, the staff you have available, the money available, and policies at your institution regarding departmental computing.

Microcomputers. Stand-alone micros work best for smaller, isolated applications that do not need to share data files with other programs on line, and only need to be accessed by one user at a time. They often are the best solution if there is no programming time available, as many software packages can be purchased and set up by the users themselves. A certain amount of centralized control, documentation and security is lost when users have their own systems, however. Electronic networking of micros is becoming an option when files or special peripherals such as printers or plotters need to be shared. A microcomputer is often the least expensive solution.

Minicomputers. These mid-size computers are often dedicated to one department or function. They work well when systems are interrelated (share data files on-line), many users need to be running at the same time, files and data bases are larger and have heavier processing requirements, dedicated programming time is available, and systems need to have more flexibility than mainframes usually offer. They will require a staff for programming and systems operation, and are a more expensive alternative than micros. Most minicomputers have communication options that allow interaction and file transfer with mainframe computers and micros.

Mainframe computing. A system should be placed on a mainframe computer if the files are extremely large, heavy processing is required, or if there is a large amount of on-line interaction with central university systems. Many times this may be the cheapest alternative or university policy will dictate that systems will be developed on the mainframe only.

Step Five: Software Options

Two software alternatives exist--custom programmed or package software.

Custom programmed. The advantages of developing your own software inhouse are that the product is uniquely tailored to your needs and procedures and can be modified more easily in the future as changes become necessary. Inherent problems with this approach include longer development time, possibly higher cost, and the need for dedicated programming staff.

Package programs. Buying a program from a vendor offers a system that has had most of the bugs worked out, a quicker implementation, and a possibly lower cost. The drawbacks are that the organization may need to adapt to the system, the program won't be as easy to change, and there will be annual software maintenance charges. Many trade journals or computer magazines can help you find available packages. Also, many universities will sell programs they have written. Be sure to itemize your needs before reviewing software packages, so you will focus on the needs rather than the "bells and whistles" of all the packages.

Step Six: Hardware Needs

Refer back to your original systems analysis to determine your hardware needs.

Terminals. How many people need to use the system at the same time, and for how many hours per day? Someone using a terminal 35-50 percent of the day will generally require their own terminal. The functions they perform will determine the type of terminal--word processing, data entry, casual viewing, or graphics.

Peripherals. What are your printing needs, in terms of volume printed each day, number of documents printed at the same time, and quality of print required? What graphics need to be plotted?

Storage Devices. What is the volume of data that will need to be maintained? Double it for your estimate. Where does it need to be maintained--on a central hard disk or on scattered floppies? How will data backup be handled--copy to tape drive or to another disk?

Step Seven: Purchase Options

There are typically four options here:

Time Sharing--buying computer time from someone else's computer. There is less initial cost and commitment, but lack of control and higher expense in the long run.

Rental--renting the equipment and/or software requires less initial cost, no maintenance charges, and makes it easier to change models in the future. It is expensive in the long run, and subjects you to unanticipated price increases.

Lease--ownership options are often available. This, again, has cheaper up-front costs, but there may be penalties incurred if the lease is broken.

Purchase--Higher initial cost, but lesser long-run cost. Greater control over the system is gained, but this is accompanied by greater risk and responsibility.

The option you consider will depend, in large part, on the budget available and policies at your institution.

Step Eight: Request for Proposals

At this point, you should have a fairly good idea of what you want, in terms of hardware and functioning, and probably have three or four vendors in mind. You will need to work with your institution's business office, data processing department, and/or purchasing department to prepare a Request for Proposal for your computer system. There may be a standard university format for this document. If not, CAUSE (The Professional Association for the Development, Use and Management of Information Systems in Higher Education) or APPA institutions may have some samples and guidelines that are helpful. The information you have documented in your analysis will be used in the system specifications. Be sure to request information on how the vendor handles system upgrades, support, delivery, and installation, and what the vendor's long-range plans for the system are.

As with any other major purchase, set up evaluation criteria and an evaluation matrix, properly weighting the factors you consider important.

After receiving the proposals, the evaluation process should include system demonstrations and possibly visits to the vendors' branch offices. You should also visit and/or contact other companies or institutions who have installed the system you are considering. Find out why they purchased it, how it has performed, if the users are satisfied, what the response time has been, if the vendor provides good support, and if they would buy it again.

The Request for Bids will then be prepared, modifying the Request for Proposal as needed, now that you have even more knowledge of what you want and need. (Do not slant this to one vendor, however; stick to your established evaluation criteria.)

There will probably be at least two systems that meet your needs almost equally well and are comparably priced. Be sure to separate the personality of the salesperson from the qualities of the system--the sales representative won't be around when there are problems! Then select the system that best fits your criteria and with which you feel most comfortable.

Step Nine: Implementation

Now the real work begins! The system purchased comprises only 50 percent of the project's success--a well-managed implementation is the other 50 percent. Again, each system implementation is unique, making it impossible to outline a plan that would fit all situations. Generally, your normal project management method will apply to computer systems as well as construction projects. List all tasks associated with the implementation, and organize them on a time line. The tasks will fall into these main categories:

1. Site Preparation--Special power, cabling, air conditioning requirements, new furniture or rearrangements.
2. Supplies--New forms, ribbons, tapes, cleaning supplies, paper, disks, etc. required by the system.
3. Training--Instruction of system operations staff, programmers, users. This is extremely important, as a system will be poorly accepted and never used to its full capabilities if the people have not learned to use it correctly.
4. Data Conversion--Preparation for changeover from old systems. May involve rekeying of information or planning for electronic transfer of files.
5. System Factors--Tasks on the data processing side to make the system operational, such as learning the operating system, establishing backup procedures and system security measures.
6. Testing--Ensuring the system works as specified and data is handled correctly by the computer.
7. Documentation--writing and/or disseminating user guides and procedures manuals. This is important now for user understanding, and important for the future when working on enhancements to the system.

One word of caution on implementation planning is to be realistic (over-cautious) on time estimates. Remember that a poorly planned project takes three times as long to complete as estimated; a well planned project only twice as long.

System development can be pictured as a cycle--as soon as the implementation is complete, the development process for enhancements and changes begins again. A truly good computer system is not "carved in stone", but is dynamic and can easily respond to changes in your organization.

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Managing for Excellence: A Model for Physical Plant Administrators

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Excellence has become the buzz-word of the eighties. Unfortunately, much of the literature dealing with excellence explores the subject from a level that has little practical application for the middle manager. While we can control our behavior as managers, we do not necessarily have control over institutional norms and behavior. Most of the current books stress overall institutional excellence while neglecting the perspective of the departmental or divisional manager, who may have little influence on the total organization, but can have great influence within his/her operational area.

My goal today is to outline for you a model for managing physical plant operations which will produce "excellence" and focus our attention, as directors, on strategic planning rather than the "small stuff."

As I see it, "excellence" is characterized by:

1. energy and commitment among subordinates.

2. a cohesive team, with a strong sense of caring and support for one another.

3. short, problem-solving meetings.

4. healthy competition, not with one another, but against a widely shared standard of excellence.

5. a belief in the abilities and good intentions of one's subordinates.

These are the attributes which David Bradford and Allan Cohen discovered in high-performing departments within organizations and outlined in their book Managing for Excellence: The Guide to Developing High Performance in Contemporary Organizations.

Before I sketch out the model for you, however, I would like to spend a few minutes reflecting on the state of most organizations today. Jerry Harvey, a professor of management at George Washington University, describes most formal organizations as having two essential functions: (1) producing whatever it is they produce, and (2) turning people into phrogs.

In such organizations, it is much more important to follow the chain of command than it is to act sensibly. Phrog is spelled with a "ph" because people don't like to be known as frogs. Obviously, as in many organizations, rather transparent means are used to hide phrogginess.

Phrogs lead solitary lives in the swamp. They don't get involved with, or communicate with, other phrogs. After all, someday you might have to take over the other phrogs' lily pads. The language of the phrog farm is Ribbitt. It is a one-word-language, resulting in a great deal of noise generation and very little meaningful communication.

Most phrogs spend more time flicking flies in the fog than in draining the swamp. This circular behavior yields zero long-term results. After all, draining the swamp would remove the flies; therefore, phrogs maintain the swamp. Most phrog managers are members of the SMA (Swamp Maintenance Association). Their job is also to maintain and enhance the swamp, rather than to drain it.

Bullphrogs are greatly revered in the swamp. Their magic is derived from others' belief that the magic exists. (This is truly a case of the emperor's new clothes!) Belief in the Myth of Bullphrog Power prevents one from taking responsibility for the fog, mud and moss of the swamp.

Favorite phrog expressions are: "We've always done it this way," or, "Policy doesn't allow us to do that," or, "It's not my job." The result is that change, if it happens at all, becomes a process of two steps backward for every step forward. This can be a real problem today when change and lack of predictability are a way of life.

Of course, none of us lives on a phrog farm and we have never uttered any of the three phroggy expressions. If Harvey's description of organization lacks recognition for you, let me recite for you Rosabeth Moss Kanter's "Rules for Stifling Innovation" (from The Change Masters):

1. Regard any new idea from below with suspicion--because it's new and because it's from below.

2. Insist that people who need your approval to act first go through several other levels of management to get their signatures.

3. Ask departments or individuals to challenge and criticize others' proposals. (That saves you the job of deciding; you just pick the survivor.)

4. Express your criticisms freely, and withhold your praise. (That keeps people on their toes.) Let them know they can be fired at any time.

5. Treat identification of problems as signs of failure, to discourage people from letting you know when something in their area isn't working.

6. Control everything carefully. Make sure people count anything that can be counted, frequently.

7. Make decisions to reorganize or change policies in secret, and spring them on people unexpectedly. (That also keeps people on their toes.)

8. Make sure that requests for information are fully justified, and make sure that it is not given out to the managers freely. (You don't want data to fall into the wrong hands.)

9. Assign to lower-level managers, in the name of delegation and participation, responsibility for figuring out how to cut back, lay off, move people around, or otherwise implement threatening decisions you have made. And get them to do it quickly.

And above all, never forget that you, the higher-ups, already know everything important about this business.

Now, surely those of us who could not identify with Harvey's phrog farms can identify with Kanter's rules. Indeed, on occasion (rare, to be sure), we have even invoked one of those ten rules.

I'd like to continue my digression for a little longer to review for you the eight attributes which Peters and Waterman (In Search of Excellence) found in excellent, innovative companies. They found that these companies:

1. had a bias for action characterized by the expression "Ready. Fire. Aim." In other words, they were not afraid to try something new.

2. stayed close to the customer, listening intently and regularly. Some of their best product ideas came from listening to the customer. (There's a moral in that for us.)

3. encouraged autonomy and entrepreneurship and expected people to make mistakes.

4. attained productivity through people. The rank and file were the root source of all quality and productivity gains.

5. were hands-on, value-driven. The basic philosophy had more to do with their achievement than their technical or economic resources.

6. stuck to their knitting and did not venture too far from their basic expertise.

7. kept their organizational form simple and their corporate staff lean.

8. had simultaneous loose-tight properties. They were fanatical about core values, but pushed autonomy way down the line.

In contemporary organizations, change and a lack of predictability are a way of life. Not taking action to drain the swamp is inherently dangerous because it leaves the responsibility for action in someone else's hands and, whenever that someone else pulls the plug on the swamp, we'll be sucked down the drain, lily pad, flies, fog, and all.

Physical plant operations in colleges and universities are seldom seen positively by their clients. At best, they are seen in a neutral light; at worst, they are characterized as incompetent, unresponsive and unprofesssional. Of course, we have a great many hurdles to overcome. Our physical plants are often antique and a challenge to the best engineers and mechanics. Most of us have deferred maintenance in the millions of dollars. Our budgets are inadequate and are often the first to be cut in a financial crisis. For the phrogs among us, all these are more than adequate justification for staying on our lily pads, weaving the Myth of Bullphrog Power and flicking at flies. But I would like to suggest that we can drain the swamp; we can change our image on campus; we can instill a sense of pride and caring in our people.

Managing for Excellence proposes a new model of leadership, one that Bradford and Cohen tested with more than 200 middle managers. The model is based on the six characteristics they found in high-performing departments (which I listed earlier) and on three things most managers want: (1) to be able to pick and build their own team, (2) to have an exciting job that is important to the organization, (3) to have the boss get out of the way.

Essentially, what Bradford and Cohen propose is that imperfect jobs can be (indeed, must be) reconceptualized into an exciting vision. I would like to suggest that among the most imperfect of jobs is that of the physical plant administrator, and that this model is both practical and can give us a good reason for getting out of bed in the morning.

One of the great paradoxes of this model is that, as a result of the changing nature of work, the key to excellence lies not in the manager, but in his/her subordinates. It is the subordinates, individually, who have the time and ability to keep up with the specifics of change in their areas of expertise and to keep close to the client. It is the physical plant administrator's job to orchestrate and manage the change. As a result, the only way to keep up with change is the shared-responsibility team with a vision to drive it.

The first step is, obviously, to formulate the vision, or goal. It should reflect the basic purpose of the department, be feasible, challenging, and have some larger significance. Given the magnitude of the deferred maintenance problem on most campuses, your goal should not be to create a perfect physical environment overnight. Consider the physical, financial and personnel limitations facing you and the overall mission of the institution, and use your subordinates to help you shape a vision they can all adopt. (Remember, Peters and Waterman found that "excellent" companies worked through their people.)

Never underestimate the importance of the vision. It is a major source of potential power for the manager. When formulated carefully and kept before the group, it becomes the driver, not the manager. This means less coercion, more focus on the larger issue, and better conflict resolution because the goal is the motivator, not the personality of the manager. While consensus is desirable, it is less important in the formulation of the goal than in its implementation. Most goals have enough stretch to allow flexibility in implementation, but the bottom line is that it is the responsibility of the manager to create it.

Once you have created the vision, share the responsibility for implementation. Do not try to be the Lone Ranger and do it all. One of the paradoxes of this model is that you gain power by giving it to your subordinates. This runs counter to the conventional wisdom which says power is a zero-sum game (i.e., if you have more, I have less). In this model, power is gained by concentrating on one's peers and subordinates. The reality is that high-performing subordinates increase power sideways and upwards because they enable the manager to deliver on his/her obligations and promises. The crucial assumption is that subordinates want to learn, grow, and take on added responsibilities. Over and over again, research has shown that people who have control over their lives are more likely to accept responsibility for outcomes and to want to make positive changes. They are less likely to accept tradition, policy, or job descriptions as reasons for not doing something.

The analogy of a basketball team is appropriate here. The coach may be demanding and inspirational, but she/he does not produce the end result. The team does, and it is done by bringing out the best in individual players, using strengths, supporting weaknesses, and working together toward a common goal. You don't have to have a team of superstars to produce an excellent result, as Villanova proved this spring. They came into the finals as the underdog against Georgetown with its superstar (Patrick Ewing), and everything just clicked and they walked away with the championship. Our management teams can do likewise.

Together with sharing responsibility for outcomes, the physical plant administrator must create an atmosphere where communication is open and supportive. This is absolutely necessary and is more easily said than done. My experience has been that game-playing is almost inevitable within organizations and can consume a great deal of time and energy if it is not nipped in the bud. For example, I have seen subunits within physical plant departments consistently fail to keep one another informed on items of crucial import. The usual result, in addition to the antagonism that builds up, is that some things get done twice, rather than once, because everyone double-checks everyone else.

Now clearly, this is a waste of time and it cuts down on efficiency and the service we give our clients, not to speak of the aggravation and hostility created on what is supposed to be a team. After all, the more time we spend gaming one another, the less time we have to do our work. On phrog farms, of course, acting sensibly is not rewarded. But in a high-performance organization, we cannot tolerate this. So, as bosses, we must model the behavior desired and call the games every time they are played. The petty antagonisms that inevitably build up in even the best relationships must be dealt with, and we often have to teach our people how to confront each other constructively. Interpersonal conflict/disagreement is normal--witness the spats in even the most loving of families. In organizations, too often, we have chosen to deny feelings and repress conflict, and the result is that buried resentments and unresolved issues actually get in the way of the work.

The manager models the desired behavior by being honest about his/her own feelings, legitimizing the existence of interpersonal conflict, and helping to work through the issues in as constructive a way as possible. The first few times, this approach takes longer, but the end result usually is that the team members will learn to work out the issues on their own because they are committed to the team's goal.

Along with creating the vision, sharing responsibility and legitimizing conflict, the high-performance manager must learn to get out of the way of his/her subordinates. This is more easily done with managers who are responsible for areas not within their own range of expertise for the very reason that they are not the technical experts in the area and must depend on the subordinate's ability. "Letting go" is not quite so easily done in areas where the manager is expert, but the letting go is, perhaps, even more important here. Subordinates do not develop their abilities, stretch themselves, if the boss always jumps in and does the work for them. The manager's role is to shape the vision, keep it in front of his/her subordinates, and help them work out their differences. Manage the work, don't do it for them!

Excellence is possible and it can be a very rewarding experience to undertake a project such as this for several reasons:

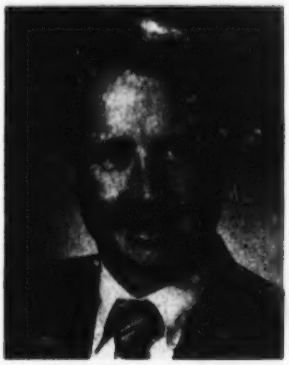
1. Most of us have no idea what our people can really do when challenged.

2. When allowed some autonomy, subordinates invest much more energy in their work and the result is invariably better.

3. It is extremely rewarding to watch people grow and gain new expertise, and it builds self-confidence on the part of the subordinate and the manager.

4. There is always too much to do and neither enough time nor enough people to do it the conventional way. The shared-responsibility team is greater than the sum of its individual parts and, for many of us in an era of tight budgets, it is the only way we will be able to improve our departments.

My personal experience has been that it is very hard, very rewarding, and very exhilarating. As I learn to share the responsibility more and more, and get out of my subordinates' way, I discover that I am, above all, a mentor, not doing things for my subordinates, but helping them figure out ways to do it themselves. And I discover that I have more time to think, to look ahead to anticipate change rather than always responding to it, and more time to plan.



Procedures for Manpower Scheduling

By Paul F. Tabolt
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Declining enrollment, fiscal retrenchment and increasing deferred maintenance have increased the pressure upon physical plant organizations to more effectively utilize the work force for maintenance, repairs, and service requests, as well as renovation and alteration projects. On a national basis, 80 percent of college and university expenditures are apportioned to salaries and fringe benefits. A closer look at physical plant tasks indicates approximately 70 percent of project costs are consumed by the human resource in the form of salaries, wages or benefits. It is, therefore, imperative that the human resource be utilized in the most effective and efficient manner in order to accomplish as much as possible with presently limited fiscal resources.

Morale and motivation as major factors influencing productivity cannot be overlooked when assessing manpower utilization and must be considered as an issue that extends beyond this topic. At the same time, it must be kept in mind that morale and motivation can suffer dramatically if manpower planning and scheduling procedures are not in place.

Manpower planning and scheduling benefits a physical plant organization as a short and long term process that selects and assigns the work to be performed while maintaining and adjusting the size of the available work force to meet seasonal and other fluctuating workload demands. The manpower planning and scheduling process in more sophisticated levels of development includes centrally receiving, prioritizing, monitoring, scheduling and following up on all work requests regardless of their magnitude. Centralized manpower projections can then be developed to determine long range manpower needs for many categories of physical plant employees. The concept of a centralized structure also permits independent quality and quantity control, customer information services, and customer feedback on services already performed. The work control center, as an organizational entity, can be established to perform these tasks.

The Work Control Center

The development of a work control center and the organizational framework from which it operates will depend upon the size and complexity of an institution. Large institutions may have work control centers that involve distinct organizational structures including staff and clerical support with clearly defined authority and responsibility. Smaller institutions, on the other hand, may have to incorporate work control center concepts into the responsibilities of first line supervision. Regardless of institutional size, the basic framework of a work control center can improve upon the utilization of the human resource through planning, scheduling, and control programs.

As an organizational concept, several responsibilities can fall within the range of a work control center. Possible responsibilities are listed below:

1. Receives and records incoming requests. Requests for service, maintenance and repairs have historically been associated with work control center concepts, but the process can also be expanded to include renovation, remodeling, refurbishment and major maintenance requests. The central receipt of requests encourages the elimination of duplicate requests, as well as possible grouping of requests by the skills or the location of the work to be performed. Facility audit and inspection services can also be organizationally aligned with the work control center organization. Such an arrangement can help to preserve facility integrity as direct input from an inspection staff is processed for immediate maintenance and repair needs, along with input that is gradually identified, developed, and prioritized for major and deferred maintenance needs.

2. Establishes a customer relations tone. The work control center can be developed into a primary point of contact for much of the institution's community. As a nerve center, the work control center should have a formalized communications network with the community, particularly if colleges and departments are willing to assign specific communication roles for specific tasks to their employees. The establishment of a formal network is not an easy task, but one that provides great rewards as members of the community learn how to work with the physical plant organization through their regular contact.

The empathetic ear of a work control center employee can help soothe a disheveled member of the community while also drawing out as much specific information about the request as possible. Obviously, the more known about a request at the time of its origination the easier the remainder of the task is likely to be. Regular interaction between the work control center and the community can lead to quality feedback regarding physical plant services provided. Formal questionnaires inquiring about services rendered can be developed, distributed, and analyzed to determine how the community feels the Physical Plant organization is performing.

3. Starts and maintains the time clock. The progress of requests can be centrally monitored and tracked from inception to completion. Physical plant management then can readily determine what item is in whose hands at any given time and for how long it has been there. As an item grows older,

its priority should often times increase. The work control center should be responsible for following up on any significant delays in the design, estimating, scheduling, or material procurement stages; and should also be responsible for providing management with reports that reflect upon the overall workload situation.

4. Establishes priorities. The blending of academic, research, administrative, maintenance and operational needs is a complex task that if left to the wrong group of employees or section of an organization, can be done with favoritism, discrimination, or general procrastination. The independent work control center should be charged to work with all parties to identify and establish priorities as well as to resolve priority discrepancies. Centralized priority establishment permits an organization's philosophy and goals to be continuously and consistently interpreted.

The need to maintain and operate the facility during emergency situations is so paramount to other physical plant responsibilities that some method of handling minor crisis situations should be found; otherwise, the remainder of the work force will be plagued with constant interruptions that prevent continuous efforts leading toward the completion of priority or routine tasks. The cost of emergency work is known to be more expensive and has been estimated to cost 30-50 percent more than that which is preplanned. In most emergencies, a lack of preplanning is usually unavoidable and is apparent when the wrong trade skills arrive at an emergency job site or a tradesperson arrives at the site only to depart within minutes to search for equipment or materials necessary to diffuse the pressing situation. A small crew dedicated to emergency tasks can provide immediate relief in emergency situations. Final maintenance and repair work related to the diffused emergency can then be scheduled for other work crews on a more routine and planned basis.

5. Prepares estimates. The preparation of quality estimates is so vital to the success of the planning and scheduling process that formalization must be suggested for organizations that operate in an informal mode. The estimate is the backbone of manpower planning and scheduling because it provides physical plant organizations with a detailed plan of the work to be performed. An estimate is of little value if it does not include specific information about the amount, types and sequence of labor, material and equipment for a task. Estimates are necessary not only for budgetary allocations, but also for the preparation of daily and weekly work schedules. The estimate should provide information for material procurement and the necessary sequence of material arrivals so that employees with material expediting responsibilities can coordinate material arrivals with work schedules. Furthermore, a statistical analysis of estimates can provide a focus on manpower backlogs, historical manpower requirements, and comparisons of estimated and actual manhours to gauge overall work performance.

Through the years, estimating has been in the process of evolving from an art to a science, although realistically the artful aspect of estimating will most likely never totally disappear. Many of the better estimators rely upon personal experiences from the trades when preparing estimates. Past practice and comparisons to other similar tasks quite often are the gauge for how long a project will take and how much material will be required. A higher level of estimating sophistication has been reached with the publication of various estimating guides such as "Means" estimating guides or "Dodge Construction Systems Costs"; but, even so, all of these estimating methods rely upon actual production as a standard. The value of estimates derived from history, experience, or estimating guides, is based upon how long the actual performance took, rather than how long it should have taken. By accepting actual production standards, there is an implied acceptance of productivity or non-productivity dependent upon which standard happens to have been involved in the sampled work situation. If actual experiences include avoidable non-productivity, then that non-productivity is inherent to such estimates.

An interesting estimating process established in the 1950's by the Navy stepped away from the acceptance of the historical performance standards with the development of Engineered Performance Standards (EPS) based upon time and motion studies that were intended for maintenance and renovation applications. In the 1970's the Government Accounting Agency recognized the value of the Engineered Performance Standards system by recommending its application to the entire Department of Defense.

The Navy has defined the Engineered Performance Standards systems as follows:

> EPS represents the average time necessary for a qualified craftsman working at a normal pace, under capable supervision and experiencing normal delays, to perform a defined amount of work of a specified quality while following accepted trade methods.

In practice, every estimator must draw upon all of the resources available including experience, history, estimating guides and engineered performance standards if an estimate is to be of high quality.

Estimates, once complete, serve the purpose of building schedules, determining backlogs, projecting manpower needs and measuring organizational performance. When considering the assessment of performance, it is pertinent to consider performance and productivity as issues which are not only restricted to blue collar workers. Performance and productivity are organizational issues that must be reviewed to determine how the organization may impinge upon blue collar productivity. The quality of the estimate, the specific materials purchased, material handling procedures, the quality of the design, scheduling accuracy, the availability of proper tools and equipment, and the quality of the supervision must be considered in any evaluations of performance and productivity. Before pointing the finger at the labor force, there is a primary responsibility to look at the organization that defines, details, plans, schedules, and supervises the work, as well as the organization that purchases and handles materials and equipment. Only after considering management's performance can blue collar productivity be assessed. When management is comfortable with the environment they have created, then the issue of productivity should come to the forefront.

6. Develops and monitors work schedules. Physical plant organizations operating without scheduling systems are likely to recognize the absence of such systems through previously mentioned signs of customer favoritism or procrastination; or through a lack of accountability as to the whereabouts

of the labor force; through material, equipment and labor requirements that do not coincide or blend together in the proper mixture on any given project; or through facilities that are not available at the time renovation work is to begin. The work schedule is the culmination of the planning effort and requires coordination between customers, facilities, trades, storerooms, and the equipment pool if the plan is to be effectively implemented. Those in the scheduling operation must have access to all of the vital ingredients of a project. One overlooked ingredient can ruin the finest project plan.

Once the planning has been completed, daily work schedules are necessary for routine maintenance and repair tasks. Work orders with materials and equipment on hand that are selectively issued to supervisors based upon assigned priorities and in quantities that closely match the manhours available are likely to lead to successful conclusions. Daily follow up and return of incompleted tasks permits the work control center to monitor progress.

For larger maintenance tasks and renovations, weekly work schedules can be forecasted using centrally established priorities and estimates. Forecasts can then be reviewed with the line operation in order to finalize the schedule of activities for the upcoming week. Again, progress must be monitored and deviations from the schedule by the line organization need to be brought to the attention of the work control center, preferably via a formal exception reporting procedure.

7. Forecasts long term manpower requirements. The work control center should be responsible for the management of the statistical data routinely processed and using such information, should forecast areas where there is excessive manpower or areas where manpower shortages are likely to occur. Combinations of information permit an assessment of the manpower available versus the manpower needed to complete projects on a timely basis. Historical task input, actual work on hand, the ratio of estimated to actual manhours for specific trades, vacation schedules, projected absences for sickness, and anticipated new projects can give the work control center insight into manpower adjustments that must be made if response time goals are to be accomplished. Overtime decisions, temporary hirings or transfers among trades can provide temporary relief to workload peaks and valleys. The need for permanent manpower changes such as increased or decreased crew sizes can be identified by the work control center.

8. Establishes an independent quality control center. Physical plant managers have a responsibility to those requesting service to provide quality service that is warranted good! The quality of service provided can be evaluated in a more objective fashion by staff members possessing technical knowledge and skills, and by staff members who are less directly involved in the performance of the work. The work control center can be a logical location for audit and control activities. Quality control inspections can be random, targeted to a known problem area, or based upon complaints received. The information gathered by those involved in quality control activities can provide management with an independent in-house assessment of problems that can lead to potential long term training and operational benefits.

Obviously, the work control center concepts described in this document can be very complex. Depending upon institutional size and circumstances, these concepts can be drawn from to establish appropriate responsibilities. The larger the institution; the more sophisticated the work control center is likely to be.

As a final note, the success of the work control center depends upon the support it receives from the institution's administration and physical plant's upper management. Organizationally, the work control center fulfills a staff function and thus should be separate from the line organization. The center needs to have clearly stated and defined authority and responsibility for estimating, prioritizing, scheduling and appraising work performance. Decisions and recommendations from the work control center for overtime, temporary transfers, additional manpower or even layoffs must receive upper management's attentive ear if the work control center is expected to balance and adjust the available manpower with manpower needs.

Selecting and Installing Your Own EMS

By Joseph D. Mikesell
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At this point, many of you, perhaps most, have some type of computerized energy management system (EMS) at your facility. Purdue University is only now installing a system on the main campus in West Lafayette, Indiana. In the 1970's, Purdue opted to invest its energy conservation dollars on low cost, quick pay back items and on major retrofit projects like VAV conversions, attic and roof insulation and new energy efficient windows and doors. The State of Indiana's budgeting process combined with our relatively low energy cost and administration imposed two year payback requirement prevented us from purchasing a central EMS. That made Purdue the last school in the Big Ten and perhaps the last large University in the country to get an EMS.

Our situation changed when Public Service Indiana (PSI), our local electric utility, began constructing the Marble Hill Nuclear Power Plant on the Ohio River. Ten years ago in 1975, our electricity cost $.0095/KW with a $2.05/KVA demand charge. Today our costs are $.017/KW with a $10.00/KVA demand charge.

Predictions as recent as 1983 were for our costs to be $.024/KW for energy and $25.00/KVA for demand by 1987 when both Marble Hill generating units would be on line. Coupled with that, the State of Indiana was in a recession in the early 80's and struggling to change the funding formulas for State Universities. So, with state financial support on the decline, and electricity costs escalating, we had little choice but to purchase a system to offset some of the expected increase in demand charges.

Another problem we had associated with the recession was delayed state funding for repair and rehabilitation projects. Our Maintenance Department had grown large and dependent on recurring dollars provided by the State and when one years funding for these items was postponed, the situation looked like lay-offs would be necessary.

Our solution was simple. We obtained permission from the State of Indiana to sell bonds to finance the purchase of an EMS which would pay back in an estimated three years. The installation was planned with our own craftsmen, providing work until funds were released for previously approved projects.

For those of you who are contemplating the purchase of an EMS for the first time, or are planning to replace a system purchased maybe ten years ago, I will outline the seven step plan that we used at Purdue to specify, select and install our system.

Step One: Identify the Need for an EMS

Of course, our need was to offset electric cost increases, but you may have several other reasons: (1) save money on the electric bill, (2) save money on the heating fuel bill, (3) replace obsolete controls, (4) monitor critical functions or areas or to minimize damage losses, (5) save man hours for inspection, troubleshooting and control adjustment, (6) provide access control and security and (7) provide fire annunciation. Your focus should be on the items that are relevant to your situation presently or in the near future.

Perhaps you alone have the perspective to know best what is needed in an EMS at your facility but I suspect others on your staff have an interest and should be involved. Include representatives of the crafts that will install the system, operate and maintain it in all phases of the project. Involvement brings commitment and will result in a system that will be understood and utilized, not criticized and disconnected.

In general, I would categorize energy management systems into three types.

The first type is the basic system which provides ON/OFF control and status feed back including both digital and analog inputs. Such software features as programmed start/stop, duty cycling, flow and temperature alarms are the main items to choose from. This is the least expensive system and generally has the best payback, 1½ years on the average.

Type two includes the features of type one plus energy saving optimization programs. Optimized start/stop, modulating control of heating and cooling terminal devices, mixed air reset, economizer or enthalpy control of outside air intake, temperature constrained duty cycling, peak demand limiting, boiler and chiller optimization, night set-back and speed control of fans and pumps covers the main features. A more sophisticated computer system is required and on the average will have a longer payback than a system with type one features, usually about three years.

Type three systems would include any or all of the features of the first two groups plus items of a facility management nature. Remote metering, trending and data gathering, access control, security, fire annunciation, maintenance management reports (e.g. motor run time and dirty air filters), work order generation, user programming, word processing and other features which may be required to efficiently manage a department, building or whole campus. Paybacks on these systems often take five years or more.

Contact control vendors you have experience with and begin a dialog with each one on the types of systems they offer and features available. They can provide invaluable help in explaining hardware and software choices and can provide necessary cost information for budgetary considerations.

Step Two: Inventory Your Facility

At this time, a list of all potential motor loads should be identified, listing nameplate horsepower, measured running KW if available, present operating schedule, type of system and area served. Note any information relevant to a particular load's potential for savings or exclusion as a point on the EMS.

The same procedure applies to pumps, lighting systems, boilers and chillers. If appropriate, inventory heating coils, cooling coils, mixed air controls, air filters and fan speed control applications.

Depending upon the scope of your project and the type system you have selected (i.e. type 1, 2, or 3), list meters such as electric, steam flow and BTU, access control points, data gathering requirements and if appropriate, fire annunciation requirements.

In general, inventory everything that might potentially be included, limited only by your preliminary decision on system type.

Step Three: Choose the Features You Need

Presumably, you have talked to vendors by this time and are becoming familiar with the common hardware and software options available. Based on your selection of system type, the magnitude of your inventory of loads, points, etc. and your fiscal constraints, you should now be at the point of making a decision on the architecture of the system and the amount of computing power required. Your situation may call for one stand alone panel, a network of stand alone panels, a host based system with dumb data acquisition panels or a host controlled distributive processing system.

Keep in mind that the greater the potential savings generated by an EMS, the greater the possible loss if it fails at the most inopportune time. Failures are inevitable and should be considered when selecting the system architecture.

The steps taken thus far should allow you to establish the scope of your project, a ball park budget, a rough physical point count and a system architecture which satisfies the reliability and centralized monitoring criteria established.

Step Four: Prequalify the Bidders

By this step you should have some idea of what is available. Depending upon the features and number of physical points on your system, the list of potential bidders could be quite long.

It is important to remember that when buying proprietary hardware future expense of maintaining it, repairing it, adding to it and replacing it depend mainly on the vendor. You should not overlook this fact, especially if you are planning a large system of several thousand points. You must be satisfied that the successful bidder will be able to meet your needs for engineering, parts and service.

Develop a list of requirements for your project, including vendor qualifications, and begin the process of prequalifying potential bidders.

If not provided, request lists of customers who have working systems installed and contact them. Many vendors will take prospective customers to visit previous jobs. If this is done, be sure to contact a few others at random to get a more representative view point rather than only the showcase installation.

Determine what unexpected problems were encountered and how they were dealt with. Very few systems are trouble free and you must be prepared for the problems you may encounter.

Step Five: Prepare the Specifications and Drawings

Many factors should be considered for this step. If you have no previous experience writing specifications, I would highly recommend seeking professional help. If you have some experience and want the chance to make your own mistakes, there are a few things I would suggest.

1. Seek advice from the potential bidders. Most are eager to help but be sure that their assistance does not result in writing someone elses system out of the specifications, unless of course, you want it that way.

2. Seek the advice of other institutions who have been down this path. You can probably obtain several specifications already written that are similar to your needs. This is a good source of material to be incorporated into your documents, but keep in mind that even the best have errors and omissions. You must remember that if you crib from another specification, you risk including unnecessary requirements in your project which translates into higher cost.

3. Stress performance rather than specific how-to's. Leave the

specification open enough to allow several ways to accomplish the same end. However, if you must have certain features, be sure that they are described clearly and not subject to multiple interpretations.

4. If you do not intend to enforce certain provisions of the specification or you can not totally justify a point or feature, do not include it. The computerized control industry has matured to the point that more features are available than ever before. If your application does not now require a particular option, check on the cost to add it later. Remember, space capacity and unused features drive up the cost.

Involvement of operation and maintenance staff is important at this stage. Making final selections of motor loads for example, to be controlled by the EMS, should involve whomever is responsible for the day to day operation. Finalized schedules of start/stop points, status points, temperature and pressure inputs and analog output signals to control heating and cooling valves should be prepared with direct participation of the maintenance people who know the equipment best. Whether they merely review and approve the drawings or actually prepare them depends on your situation, but remember, involvements leads to commitment and commitment is critical for the successful operation of an EMS.

The specification and drawings must include clearly stated intentions for installation by the Owner's personnel. The bidders must operate on a minimum of assumptions of what material will be included in the bid and what will be furnished by the Owner. Because some basic differences exist between energy management systems that can provide equivalent performance, make certain that Owner furnished items are quantified in the bidding process. For example, if you decide to provide and install power wiring to data acquisition panels, two different bids may include a large difference in the number of panels and therefore a substantial difference in what you must furnish. You must be able to compare bids, which together with your installation cost, make up the total cost. Require the bidders to submit itemized lists of devices included in their price, which your people will install. Also, have them submit installation labor estimates based on their standard estimating practice. Care must be taken to review these estimates for relevance to your facilities and adjust accordingly.

Include your proposed level of commitment of installation people, with realistic statements of skill and experience levels. Provide all information regarding jurisdictional limitations, working hours, who is liable for overtime and who will provide first-line supervision. If the contract will include a completion date with a liquidated damages clause, the bidders must be assured that sufficient manpower will be available to complete on time.

Include a requirement for installation training and have the number of hours spelled out with the bid.

Other items for special consideration include operator training, maintenance training and a maintenance agreement.

The drawings should include as much detail as necessary to assure fair competitive bids. I would recommend providing simple floor plans, to scale, showing locations of all fans, pumps, motor control centers, space temperature sensors, meters, etc. that will be included in the EMS. Depending upon the distances between hardware points and the number of points per data acquisition panel, the bidders can potentially engineer the system several ways with vastly differing costs associated with each. The best configuration should be prepared as if the bidders were furnishing and installing the entire job and well detailed plans will certainly help.

Make certain the specifications are well defined and specific in what the EMS must include and when the bids are received, double check to make sure everything is included.

Step Six: Select the Bidding Process

We all have legal requirements which govern the bidding and purchasing processes at our institution. The difficulty with purchasing an EMS is equivalent to buying fresh fruit and receiving bids on both apples and oranges.

Bidding an owner installed EMS is worse because differences in the architecture of the various proprietary systems will result in large differences in the bids. After adding your installation costs to each bid, the differences should be smaller but still equivalent to comparing apples and oranges.

Where allowed by law, the best approach is one which incorporates a formal evaluation process. Of course, all bidders must be aware of the evaluation method and the intent of the Owner, which is to purchase the best system at the best installed price, and not necessarily the lowest price. Require each bidder to submit a Technical Proposal along with the bid which should consist of a comprehensive description of their EMS including all requirements of the Specification. Contents of the proposal should be sufficiently detailed to allow you to select the best combination of bid and proposal. I would not allow the inclusion of sales brochures in the proposal.

In anticipation of questions you will certainly have about details in some or all of the proposals, plan on holding technical review meetings with the two or three finalists to be selected by a committee.

The selection and evaluation committee should be made up of representatives of the groups that have given input into the project to this point. Those individuals who will install, operate and maintain the system should have the opportunity to participate in the selection process.

The committee can evaluate the proposals and select the best overall combination of bid and technical proposal.

Step Seven: The Installation

If practical, considering work loads, and jurisdictional limitations, include operations and maintenance personnel on the installation team(s). Keep in mind that the installers should already have the necessary skills and experience to perform the work requiring only installation training provided in the contract.

Regardless of how the installation work force is structured or supervised, it is a good idea to hold regularly scheduled job meetings with the installers and contractor. Depending on the size of the project, many problems will be encountered which were not anticipated and maybe not covered in the specification. By developing open channels of communications between the installers and whomever is over seeing execution of the contract, you will have the equivalent of several inspectors in the field insuring that the job will be done right and changes, if required, will be timely.

Reap The Results

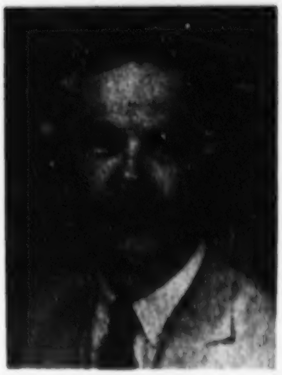
If all has gone well up to this point, your project should be near completion. The goals established in the beginning, whether to save utility dollars or provide monitoring of critical facilities will certainly be realized because you have made a commitment. But perhaps more importantly, your entire staff has made a commitment.

Purdue's experience with this approach has been very positive. The project to install a 6000 point direct digital control system in 60 campus buildings has taken two years and nearly $2.5 million dollars. Our payback will not be as quick as estimated in 1983, but tangible benefits other than money saved are being realized.

This project has developed a strong cooperative working relationship between the maintenance staff and the mechanical equipment operations staff. Although normal work routines have been disrupted to break operations people free to participate in the project, no major problems have occurred. Maintenance people with long backgrounds in pneumatic controls have adapted very well to the new direct digital control systems.

The project has been given a lot of attention and as a result all participants are proud to be part of its success.

No energy management system, no matter how sophisticated can be of any value if it is unused, ignored or disconnected. If your people have the opportunity to be involved, and the vendor supplies the product as specified, your project is a guaranteed success.



Bottom-Up Capital Budgeting

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Introduction

College and University capital budgets are prepared in a variety of ways depending upon the particular organizational structure and whether the institution is public or private. The format outlined in this paper is currently being used in a state university but is adaptable to large and small, public and private institutions.

In many institutions the capital budgeting process is driven from the top, the executive administrators; president, vice-presidents, major deans, etc., prepare a list of their pet projects to be included in the budget package, and the justification for each project is prepared as an afterthought. The selection process is often completed before the justifications are prepared! It is critical to the health of the institution that this process be developed from the bottom up. Every department must have equal access to the process and the opportunity to justify its capital requests.

This paper is supplemented with time schedules, sample forms, and flow charts that clearly illustrate how the system is currently functioning. A walk through a typical capital budget cycle will allow the reader to understand what happens at each step of development, why it is important, and how it affects the next step. This cooperative, bottom-up, development process allows unrestricted input from the department level which is culled and prioritized at the office of the appropriate vice-president, refined and assembled by the capital planning office with final adjustments and approval made by the financial vice-president.

Strategy

It is imperative that the capital planning process be open-access with ample opportunity for widespread participation from the University community. If this open-access, bottom-up development process is used, there are opportunities to gather information about community needs that would otherwise not be available.

The successful approach recently implemented at UConn is based upon a widespread solicitation of the academic and managerial staffs. Individual responses to this community solicitation must be approved and returned through the normal organizational hierarchy. In this way, the capital request is from the community user and the approval sequence is through the appropriate Dean and Vice President. This assures that each layer of the hierarchy is aware of and approves of the particular capital request. On the other hand, inappropriate requests will be stopped at some level in the organizational hierarchy if the request is not in line with organizational goals. The requests that make it through the approval sequence are collected by the Office of Facilities, sorted, and consolidated into a draft capital budget document for review.

This approach to capital planning has been in place for two cycles at UConn, has been well received and is successful by any measure. In prior years, the capital planning process was initiated by a visit of the Director of Physical Plant to a monthly Deans' meeting, usually in March or April. The Director would announce that the annual capital budget request was being prepared, that requests from the community were now in order and were due within the next two or three weeks. As might be expected, this "surprise attack" garnered few responses from the Deans and then only for very major projects. It turned out that because of the poor participation of the Deans, the capital planning process fell back to the primary involvement of the Vice Presidents of Academic Affairs and Finance and Administration, and the Director of Physical Plant. The University community was effectively cut out of the process. This approach is what I would characterize as top-down capital planning. In order to fully develop the concept of bottom-up capital planning, it is necessary to walk through a typical capital planning cycle with special concentration on the community solicitation part of the cycle. This cooperative, bottom-up development process allows broad input from the department level which is culled and prioritized at the office of the appropriate vice president, refined and assembled by the capital planning office, with final adjustments and approval made by the financial vice president.

CAPITAL PLANNING

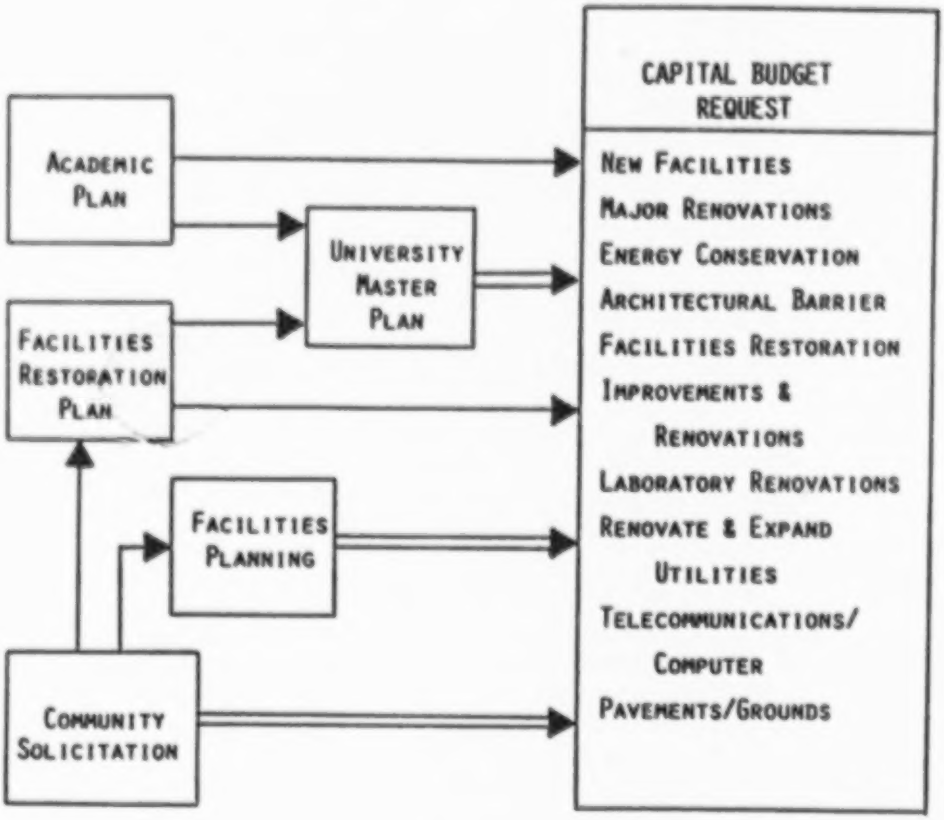
INPUTS

1. University Master Plan
2. Academic Plan
3. Facilities Restoration Plan
4. Facilities Planning
    - Utilities
    - Pavements/Grounds
    - Energy Conservation
    - Architectural Barriers
5. Community Solicitation

THE BOTTOM-UP BUDGET CYCLE

1. Solicitation (from Community)
2. Consolidation (Community responses & programs listed above)
3. Development (Capital Budget request)
4. Initiate Approval Cycle (University, etc., etc.)
5. Community Update (Community)
6. Defense (Approval Board/Legislature/etc.)
7. Approval (Legislature/Governor/etc.)

CAPITAL BUDGET DEVELOPMENT


Academic Plan
University Master Plan
Facilities Restoration Plan
Facilities Planning
Community Solicitation
CAPITAL BUDGET REQUEST
New Facilities
Major Renovations
Energy Conservation
Architectural Barrier
Facilities Restoration
Improvements & Renovations
Laboratory Renovations
Renovate & Expand Utilities
Telecommunications/ Computer
Pavements/Grounds

I. Solicitation Package. The solicitation process begins with a general mailing to Deans, Department Heads, and Directors during the first week of January each year. This mailing is designed to bring an awareness of the capital planning process to these faculty and staff administrators, and to do it early enough in the capital budget cycle that they will have time to make an intelligent response. The package includes an introductory letter, a budget process timetable, a list of investment priorities, an update of last year's request, blank request forms, an instruction sheet, and a sample completed request form.

The package is designed to provide not only a vehicle for response (blank form), but enough related information to give the potential requestor a sense of what the capital process is all about.

The introductory letter simply announces the capital budget request solicitation, outlines what is included in the package, requests that the package be copied and distributed to others in the department, if necessary, reinforces the need for organizational approval and urges compliance with the time schedule. The name and telephone number of the Director of Planning is also included to respond to questions from the community.

In order to develop a sense of urgency to the process, a timetable is included. This timetable indicates the dates by which each step of the process must be completed in order to meet the deadline of Trustee approval at the June meeting and submission to the Board of Governors in July.

The capital investment priorities as mandated by the Board of Governors of Higher Education and endorsed by the University outline the main goals of capital investment. These priorities are directed primarily toward conserving and maintaining existing facilities, improving the quality of existing campuses through renovation and reequipment, and through improved walkways, open areas, signage, and physical environment. Also included is a continuation of renovations and programs to provide improved accessibility to facilities by the student population and general public with handicapped accessibility being only part of the goal. Finally, construction of new facilities already in design or substantiated by master plan needs, enrollment increases, etc.

This overview of the capital priorities will give the potential requestor a sense of where his needs fall into the big picture of higher educational priorities.

The update on the status of last year's capital budget request is also enlightening as it lists the title and estimated cost of each project requested by the University and approved by its Board of Trustees, the recommendation of the Board of Governors, and the recommendation of the Office of Policy and Management. Historically, the list gets shorter at each step in the approval process. The Governor's recommendation to the Legislature normally follows the OPM recommendation, and the Legislature gets the last opportunity to modify the request. This status update is useful in that it gives a sense of what was approved in the last cycle and what the success rate is for getting these individual requests through the approval sequence. It also prevents the development of false hopes for success after the first stage approval.

The previously described information should give the potential requestor some feeling as to what projects will be given strong consideration, the success of last year's request, and the timetable constraints for this year's request. He is now ready to consider justifying his request on the blank Capital Budget Request Form. This form comes complete with a line-by-line instruction sheet and a sample completed form. The form and the instructions, although specific in their data requests, give ample opportunity for the requestor to leave the solution of the problem to the planning group. This was done intentionally so that the requestor would not feel intimidated by his lack of an adequate response and, therefore, not submit the form. One primary goal of the solicitation is to determine what the faculty and staff administrators see as major problems. In order for us to find out, they must submit the forms for analysis.

II. Solicitation Response. The two solicitation cycles have been a success. There were fears, initially, that the response would be small because of the complexity of the request form and the comprehensive support information. On the other hand, we were concerned that we may be deluged with requests that were frivolous or outlandish. Our fears were unfounded; the actual return for each year totaled about 200 individual responses from an academic administrative community of about 320. Multiple requests came from certain departments and none from other departments.

These requests ranged from small maintenance projects, such as painting a garage or replacing water pipes, to construction of a new $35 million Science Tower. The overall quality of the request preparation was good, and it was apparent that most of the requests were well thought out and had been discussed at the administrative level before being submitted. The number of inappropriate requests was less than ten percent. However, even those gave us an opportunity to educate the requestors of the proper procedures so that their needs could be met through proper channels in the future.

III. Consolidation. The approximately 200 requests received by the Facilities Planning Office arrived over a three-month period, some more than one month late. These were sorted into categories in order to facilitate handling. The following categories were used:

Capital - Major Category

Energy Conservation
Architectural Barriers
Facilities Restoration
Improvements and Renovations
Laboratory Renovations
Renovate and Expand Utilities
Telecommunications/Computer

Capital - Stand alone

New Facilities
Major Renovations

Miscellaneous

Prior Funding - Funded from prior authorization
Maintenance - Issue work order
Equipment - Departmental responsibility
Miscellaneous requests

The initial categorization involved identifying and separating the miscellaneous and the capital stand-alone requests. The miscellaneous category requests were inappropriately submitted and accounted for less than ten percent of the total. These were primarily related to simple building maintenance items and laboratory equipment needs of the academic community. We responded to legitimate maintenance requests by simply issuing work orders for the repairs, with a copy of the work order to the requestor. Requests for equipment purchases were returned to the sender with a note that these purchases must be approved and funded through the appropriate Vice President. They were not legitimate capital purchases. Also included in this category were legitimate capital requests that had been funded from a prior authorization but construction had not started. The requestors were notified that the projects had been previously authorized.

The capital stand-alone category has accounted for about five percent of the total response count and is defined as new facility construction and major renovation of existing facilities. The new facility category includes such diverse structures as a thirty-five million dollar Science Tower, and the $160,000 Facilities Landscape Garage at the Greater Hartford Campus. The Science Tower is significant because it would be a major commitment of state resources, and the Facilities Landscape Garage is significant because it requires the construction of an additional structure. These are normally listed as separate stand-alone items on the capital budget request because they beg the questions of Why?, Does this signal a program change?, What impact does this have on enrollment?, How did you get along without it in the past?, etc.

Typical capital requests accounted for the remaining eighty-five percent of the responses. These were subdivided and assigned into seven major categories. These categories reflect the major needs and the capital investment priorities of the University. Each is outlined below:

Energy Conservation - Repairs and/or renovations to building systems that will increase the energy efficiency of the facility. We are currently looking at simple payback periods of up to five years as a measure of acceptability.

Architectural Barriers - Any improvement of means of access/egress to buildings or within buildings, and between facilities on the University campus that is necessary to assist the mobility impaired.

Facilities Restoration (Deferred Maintenance) - Improvements or renovations to major building systems to restore them to an adequate level of performance. Last year, a 12-year, 36 million dollar Facilities Restoration program was presented to the Board of Trustees and the Legislature.

Improvements and Renovations - Physical modifications to University facilities to adapt them to changes in use due to changes in academic programs. Individual projects in this category would generally cost less than $100,000. Projects above this level would be listed in the major renovations category of the Capital-Stand-alone group.

Laboratory Renovations - Very similar to the Improvements and Renovations category except a special need has been identified for improving laboratory facilities at the University, and this category has been identified to call attention to this special need. The $100,000 limitation pertains as above.

Renovate and Expand Utilities - Any improvement or renovation of utility plant, or distribution/collection systems, parking lots, roadways, grounds, etc., necessary to maintain a reliable, safe environment for campus activities. Energy conservation projects within the Utility Plant or distribution system can be funded from this area, however, the preferred source is energy conservation, as noted earlier.

Telecommunications/Computer - This is a new category only recently added to address the needs associated with the development and implementation of a University-wide plan to replace our telephone system and to combine all voice and data into one network.

To further define these categories, it is important to note that other than the upper dollar value limits shown for the Improvements and Renovations, and Laboratory Renovations categories, there are also lower limits. The smallest expenditure that would be charged against any of these capital project categories is $5,000 + or -, and each project must have a useful life in excess of twenty years, with twenty-five years preferred. Energy Conservation projects are the exception in that expected life of the project must be at least triple the payback period.

The Major category and Stand-alone category capital project requests were reduced to their basic elements from the request form, and these elements listed in a computerized database. The elements included were:

Project Number - Arbitrary, consecutive
School/College - Requestor
Department - Of School/College
Project Description - Facility name and short description of proposed work
Priority Number - From that assigned by appropriate Vice President
Vice President - Appropriate Vice President
Cost $ - Estimate, if available
Project Category - As described earlier
Comments - As needed

The database was sorted and printed by Vice Presidential area and by priority. Each Vice President received a listing of his area's requested projects. It is important that each Vice President get a fair hearing for the priority projects from his area. The aggregate cost of all requests received would total much more than the University was willing to support in its annual capital budget request, hence, it is necessary to sift a logical plan that meets the needs of the University from the total response.

It was apparent that requests given first priority status would more than exceed the expected capital request amount. Therefore, it was necessary to select from the first priorities those critical projects that directly complemented the University's master plan. In addition, projects were selected from lower priorities if they fit into one of the major categories and could be otherwise justified. These were selected from the total group of requests and were grouped into the Facilities Restoration (Deferred Maintenance), and Improvements and Renovations (Laboratory and Other) categories. These fit into the overall plan developed by the Office of Facilities even though they were not necessarily the first priority requests of the academic departments in their request to the vice president.

After the selection of potential first priority projects and other projects in major categories, it is necessary to meet with the requestors. Many poorly defined projects needed clarification in order to improve, or establish, an estimate of cost. On the other hand, many lower priority requests that met few or none of the University's priorities, were dismissed at this time. The planning office staff met with the requestors individually and refined the estimates. These meetings presented an opportunity for the planning office staff to mingle with the community, show their concern for the needs of the academic and administrative departments, and make suggestions to improve the quality of the requested project.

The planning office staff developed programs and reliable estimates for each requested project that was to be included in the proposed capital budget. It was then a straightforward exercise to prepare a preliminary capital budget within the cost guidelines to submit to the Vice President for Finance and Administration for comments, approval, and/or change. This preliminary submission must address the needs and requests of a broad segment of the University population and support those items that are in accord with the University Master Plan. The proposed budget must have a broad base of support and be within the range of cost that can successfully traverse the entire approval process.

There are five basic questions that must be answered in order to determine if a Capital Budget Request is a viable document. These are:

1. Does it address the goals of the
   University Master Plan?
   Academic Plan?
   Facilities Restoration Plan?

2. Does it address the Capital
   Investment Priorities of the Board
   of Trustees or other appropriate
   oversight authority?

3. Does it address the short-term needs of
   the Facilities Department for major
   renewal and replacement?

4. Does it support
   the needs of the University community?

5. Is the total cost reasonable and within the
   ability of the funding authority to
   appropriate?

If "yes" can be answered to each of these questions, the budget document truly addresses the needs of the University. An answer of "no" or "don't know" to any question should raise a flag of concern, and the budget document should not go forward until the issue can be resolved and all answers are "yes".

At UConn, the Vice President for Finance and Administration and the chief facilities officer discuss and review the proposed budgetary plan and make adjustments as necessary. This preliminary plan is then distributed to the other Vice Presidents for their information and discussion at the next University Cabinet meeting. The plan is modified and/or approved by the Cabinet, and the proposed capital budget plan is then ready to be included on the Agenda of the June Board of Trustees' meeting.

At this point in the approval sequence, the capital budget request is fairly well developed and detailed support documents prepared by the planning office will usually assure approval by the University Board of Trustees. After Trustee approval, it is necessary to enter another series of hearings and discussions with the staff and members of the Board of

Governors for Higher Education. These meetings usually take place during August. By the end of August, the University is notified which projects will be recommended to the Governor by the BGHE.

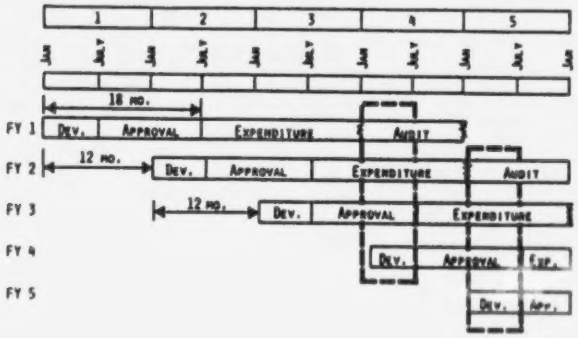
In order to complete the informational loop and keep the academic/staff administrators informed as to the disposition of the capital budget request, an update mailing is sent out early in September to the entire administrative group. This mailing includes a copy of the BGHE recommended capital budget, and a letter thanking everyone for their participation in the process. A list of proposed projects for the aggregate categories is also included. This gives each administrator the opportunity to review the list and improve his/her understanding of how the system works, which project types are likely to obtain support, and to see if his/her request is in the proposed budget.

This update mailing is not only a valuable tool for increasing the likelihood that more administrators will make requests in the upcoming capital request cycle in January, but also a good public relations device to assure the community that their interests are being promoted on a continuing basis.

The Connecticut approval cycle continues through the Office of Policy and Management, the Governor's Budget to the Legislature, and finally, the Legislative hearings with the University. The outcome of the 1985/86 Capital budget request will not be known until May or June of 1985, and by that time the 1986/87 Capital budget preparation cycle will have already been ongoing for at least five months. It is quite apparent that the capital budgeting is an endless process with at least three cycles overlapping at any one point in time.

CAPITAL PLANNING

CAPITAL BUDGET CYCLE



FOUR PHASES

1. DEVELOPMENT
2. APPROVAL
3. EXPENDITURE
4. AUDIT

BEST COPY AVAILABLE

Humble

Pawsey

Facilities Management Down Under.

Bill Humble
University of Queensland and
Maurice Pawsey
University of Melbourne, Australia.

ABSTRACT.

The authors Director Buildings and Grounds, and Controller (Buildings) respectively have initially set out to introduce their North American Colleagues to the Australian University System and its major characteristics. This is examined within the existing Constitutional Framework and methods of Financial Control and Accounting.

The core of the paper deals with current problems and trends in Facilities Management in Australia and covers Terminology and Standardisation, Life Cycle Costs, Computers in Facilities Management, Energy Management, Health and Safety, Statutory Controls, Financial Constraints, and Cleaning Management.

Many of the listed problems are being examined at a national level in three forums; the Facilities Management Committee of the National Committee on Rationalised Building (N.C.R.B.), at the Biennial Meeting of all Building Officers and through a continuous system of standardized information exchange, and more recently by the Australian Vice-Chancellors' Committee (A.V.C.C.).

The authors conclude in rhetorical vein by seeking assistance with the more intractable of their problems.

OBJECTIVES.

In this paper the authors have set out to achieve four things:

1. To introduce fellow APPA members to Australia, in particular to the Australian University System, and to highlight major variations with the North American Model.

2. To identify conditions that contribute to variations in Facilities Management in Australia.

3. To detail contemporary problems and trends in Facilities Management in Australia and

4. To detail what action is being taken to resolve the more urgent of these concerns.

AUSTRALIA AND THE AUSTRALIAN UNIVERSITY SYSTEM.

The continent of Australia, which celebrates its bicentennial in 1988, is a large country with a small population. It has a land area of 7,682,300 square kilometres (yes we have gone totally metric!) which about equates to the USA less Alaska and Hawaii.

The climate of Australia is predominantly continental but the insular nature of the land mass is significant in producing some modification of the continental pattern.

The island continent of Australia is relatively dry with 50 percent of the area having a median rainfall of less than 12 inches per year and 80 percent less than 24 inches. Extreme minimum temperatures are not as low as those recorded in other continents because of the absence of extensive mountain masses and because of the expanse of ocean to the south. However, extreme maxima are comparatively high, reaching 50°C (122°F) over the inland, mainly due to the great east-west extent of the continent in the vicinity of the Tropic of Capricorn.

Climatic discomfort, particularly heat discomfort, is significant over most of Australia. During summer, prolonged high temperatures and humidity around the northern coasts and high temperatures over the inland cause physical discomfort. In winter, low temperatures and strong cold winds over the interior and southern areas can be severe for relatively short periods.

The population is only 15,500,000 of whom about 60 percent live in the five major state capital cities, each of which is proximate to the coast. Over 70 percent live in just twelve cities. Queensland is the only state where the majority of its people live outside the capital city.

The Commmonwealth of Australia was federated in 1901 from the former Crown colonies. It comprises six states with capital cities in brackets - New South Wales (Sydney), Victoria (Melbourne), Queensland (Brisbane), South Australia (Adelaide), Western Australia (Perth), Tasmania - an island state (Hobart) and two territories, Northern Territory (Darwin) and Australian Capital Territory (Canberra). Section 51 of the Australian Constitution divides functions between the two main levels of government; Federal and State. In Australia the third level of government, Local Government is almost entirely a state responsibility and there are no rules laid down as to how power should be divided between the state and local government. The system of government at both federal and state level follows what is described as the "Westminster Model".

The national government is given responsibility for powers which require a national approach and some degree of uniformity such as defence, immigration,currency and coinage, customs, trade and foreign affairs.

The main functions reserved for the states are education, health, police, primary industries and the provision of most of the so-called utilities - water, electricity, gas etc. and the oversight of surface transport.

Despite this, tertiary (Higher Education) as distinct from primary and secondary education, is primarily a federal matter. The reason for this can be explained in one word - MONEY!

The national government collects nearly 80 percent of all the revenue in Australia. There are two main reasons for this. The national government levies all the income taxes on people and companies and this is the most lucrative taxation field. The national government also levies most of the indirect taxes, including sales tax, customs and excise duties, mainly because the High Court has decided that under the Constitution, taxes levied at the point of wholesale have to be a national government power.

The net result of this taxation situation is that state and local governments are extremely dependent on transfers from the national government for their funding and the range of areas left for them to tax is quite small.

Certainly the Universities and Colleges of Advanced Education (CAEs) are totally federally funded (since 1972). In constitutional terms this derives from Section 96 Financial Assistance to States of the Constitution. Specific grants are made each year per medium of the States Grants (Tertiary Education Assistance) Act to each of the three sectors of tertiary education. In addition the relevant Act now provides details of grants on a rolling triennial basis. For example, the 1984 Act was assented to on 25 Oct 84 and provides the following details for the years 1985, 1986 and 1987 -

Schedule 1 - Details of Recurrent Grants (Universities).
Schedule 5 - Special Research Grants for Universities.
Schedule 6 - Recurrent Grants for University Teaching Hospitals.
Schedule 15 - Grants for Equipment for Universities.
Schedule 18 - Grants for Specified Building Projects of Universities.

As an indication the total recurrent grant for 1985 (excluding Schedule 18) for the University of Queensland is $108,771,000 (Australian not U.S. unfortunately).

As will be seen from the above detail, the University system is federally controlled and federally funded. Several states have interposed a tertiary control body as an extension of the State Department of Education (there is also a Federal Minister for Education and Department of Education in Canberra). The system is not of the same kind as exists within many American States. By and large the nineteen Universities are autonomous, although capital funding is tightly controlled from Canberra. On that subject capital has slowed to a trickle with the inevitable result that there exists a substantial backlog of new buildings and rehabilitation of old buildings (CRR). This is of course in addition to the usual Deferred Maintenance problems addressed elsewhere.

Australia has a comparatively low level of participation in tertiary education. The OECD quote that the percentage of the 18-19 years of ago cohort involved in higher education is currently USA 74 percent, Japan 65 percent and Australia 45 percent. This is in part because of socio-economic predilection and in part due to lack of facilities. Quotas apply to most courses in most Universities in Australia with Medicine and Law in particular in very high demand. This can be contrasted with a youth unemployment figure of 23 percent against a general unemployment rate of 10.6 percent.

Efforts are being made by the current federal labor government to attack these joint problems. The major initiatives are being made under the heading of "participation and equity" and affect the Technical and Further Education Sector (TAFE) and Colleges of Advanced Education Sector (CAE) much more than the University Sector.

Inflation is running at 8 percent and the bank rate is 16 percent. Housing interest rates in part are controlled and run between 12-14 percent.

The three tertiary sectors (University, CAE and TAFE) are as already reported directed from Canberra. This is done by the Federal Minister for Education through a body called the Commonwealth Tertiary Education (CTEC). The Commission in turn has three Councils - Universities Council, Advanced Education Council and the Technical and Further Education Council. (Details are attached as Appendix 1). These Councils now advise the Minister on both Recurrent and Capital funding needs on a rolling triennial basis which ultimately gains reality in the grants made via the annual States Grants (Tertiary Education Assistance) Act. An extract, the CTEC Report for the 1985-87 Triennium September 1984 is attached as Appendix 2. The financial year in Australia is 1 July-30 June although all tertiary funding is based on the calendar year 1 Jan-31 Dec.

The major political parties in Australia are The Australian Labor Party (= Democrat?), the Liberal Party of Australia (= Republican?) and the National Party (previously Country Party) of Australia (=?). The Federal Government is Labor as is New South Wales, Victoria, South Australia and Western Australia. The Tasmanian and Northern Territory Governments are Liberal or Liberal /National Coalition and the Queensland Government is National Party (sometimes disparagingly referred to as "agrarian socialists"). Clearly the political complexion of the Australian electorate is currently Labor although several years ago it was Liberal/National coalition.

CONDITIONS THAT CONTRIBUTE TO VARIATIONS IN FACILITIES MANAGEMENT IN AUSTRALIA

Financial and planning.

There are very significant differences between Australian and North American conditions in Higher Education. The major variations are:

Federal Funding. The institutions of Higher Education in Australia (19 Universities and 45 Colleges of Advanced Education) are funded fully by the Federal Government. Until 1972 funding was shared between the State and Federal Governments and tuition fees were charged to students. In 1972, the Federal Government cancelled tuition fees, making Higher Education ostensibly free, and assumed total responsibility for funding. There is no similar process of approach to State Legislatures and lengthy budget examination as in your State University systems.

Lack of private funding. There is very little private funding of Universities. We do not have your great Alumni Associations with their substantial and regular pledged contributions. Funds from our Alumni come normally only in response to specific appeals or as bequests or legacies. There are few organizations similar to your great foundations and their funds are limited. Efforts are being made to change this due to a reduction in federal funding.

Research funds from industry and commerce are but a small fraction of the massive amounts injected into Universities and Colleges in the United States, although we are now moving to correct this situation as a result of declining government research grants.

The greatest government contribution to institutional research goes to the Commonwealth Scientific and Industrial Research Organization (CSIRO), and consequently research funds from Government sources are also limited.

Private Institutions. There are no private Universities or Colleges of Higher Education in Australia. There are no State Systems as in your country - no SUNY, no University of California, no University of Texas System. There are some state co-ordinating bodies, who are responsible for course co-ordination in each state and who have the responsibility for the minimal manpower planning being carried out in Higher Education in Australia.

Relationship of Capital and Recurrent Funding. One of the great difficulties in maintaining, renewing, and replacing physical assets in Australia is that capital and recurrent (operating costs) funds are kept very deliberately apart.

Capital funding is separately provided, and specifically in the Acts granting funding for Higher Education. Recurrent funds cannot be spent on capital projects. This link, so obvious to practitioners, does not exist in statutory terms.

In consequence, buildings are of necessity often built without regard to their operating costs. Decisions are made on maintenance or renewal during the life of the building, without serious investigation of the life-cycle consequences. Recurrent costs are often adversely affected by the limited capital budgets available for building projects.

Life-cycle costing and techniques are now under serious discussion in Australia and will be dealt with later.

Triennial planning and funding. Since 1958 there has been a system of triennial (three year) planning and funding for Higher Education. The theory is that each three years a series of guidelines and planning parameters is issued, intended to provide a clear indication of the funds available for the system (and each Institution) for the three years ahead for both recurrent and capital funding. In reality the system worked well until 1975 while funds were adequate. When the funding situation weakened in 1975, triennial capital funding ceased for several years and when resumed it has operated more in theory than practice. We live literally from year to year.

Absence of long term planning - financing and planning tied to a theoretical four year political term. This may not be as great a variation as others mentioned, but observation suggests that our political decision-making is more related to gaining votes and staying in power than yours. It is quite clear that little or no planning or financial decisions are carried beyond the life of the existing Government. Emphasis appears to be on short term decisions to influence the electorate, and not essential long term planning.

Statutory Bodies (Quasi autonomous non government organizations (QANGOS)). A feature of Australian Governmental structures is the Statutory Authority - a body established under Government statute, but autonomous, often responsible to Government by very tenuous lines of authority. There are some thousands of these operating in Australia, including universities. Such bodies establish charges for supply of electricity and gas - usually the monopoly supplier of such services (there are no private, commercial bodies supplying such services in Australia); they also establish rates for water and drainage and many similar public services.

Industrial relations.

It would be a relevant and not too excessive an over simplification to say that all the problems with Industrial Relations in Australia were imported from the United Kingdom. Certainly many of the over 300 (yes 300!) registered unions in Australia have their origins in the guilds or craft unions in that country. But there are idiosyncrasies, and unionism in Australia has inevitably developed a character all its own. In the view of many conservatives it is the major problem facing Australia today.

It all started long before the Commonwealth of Australia Constitution Act 1901 but it was enshrined in that legislation in Section 51 (XXXV) under powers of the Federal Parliament "Conciliation and arbitration for the prevention and settlement of industrial disputes extending beyond the limits of any one state". That picks up any federally registered union and all the most powerful are. Under the aegis of the Conciliation and Arbitration Commissions that exist at federal and state level all awards are centrally determined. It has led to comparative wage justice as an article of faith in Australia which seems to be little more than an interminable ratchet device for everybody to chase everybody else. More than anything else it is the reason why labour in Australia has priced itself out of international markets. Tariffs and quotas are also a contributing factor of course and most industry in Australia is protected directly or indirectly.

Whilst unionism world wide seems to be a declining force, it is still a significant influence in Australia with 57 percent of the work force unionised as compared with less than 50 percent in U.K. and declining rapidly and less than 20 percent in USA and also falling. This would perhaps be no bad thing if it were not that there are 322 separate unions all fighting for members. The demarcation disputes amongst competing unions are debilitating. Disputation and strikes are a way of life affecting all levels of society from doctors to cleaners. Industrial blackmail involving government monopolies providing power, water and telephones are regrettably all too commonplace. Unionism pervades Australian life.

Working conditions in Australia are very good, almost certainly too good for our own sake. The common bench mark is now 36¼ hrs per week with 18 day months, 9 day fortnights or flexitime near pervasive. An employee is by law entitled to 4 weeks' annual leave, 2 weeks' annual sick leave, 13 weeks' long service leave between 10-15 years, paternity leave, maternity leave and bereavement leave. It has been determined (by the NSW Employers' Federation) that these "on costs" add between 30-80 percent to the cost of labour. A strong campaign is now being fought by the Australian Council of Trade Unions (ACTU) the peak council, for national and universal superannuation as an addition to these benefits.

Unionism in many places is compulsory ("closed shop"). At the University of Queensland for example a new administrative employee is required to join the appropriate union within 30 days of employment. It is in the small private business area where unionism is less strong. Penalty rates for out of normal hours' work add further wage burdens.

A final word under this heading about the Contract versus Day Labour (In House) argument. It rages unabated with protagonists for both sides. It is essentially political. The Labor Party support day labour whilst the Liberal Party (= free enterprise party?) support contract labour. All levels of government and government created qangos are large employers of day labour. The selling off of these government monopolies as is happening in England and elsewhere is not being reflected in Australia. Grievance and termination procedures are strongly employee orientated.

All in all Industrial Relations is a demanding and continuous problem for the Facilities Manager operating in an institutional environment.

Academic matters.

The structure of the academic aspects of Higher Education is also very different from the USA. Our early Universities initially based themselves on the Oxford/Cambridge model, but have since moved significantly away as they have developed. The first Universities were established in the early 1800s - Sydney 1835, Melbourne 1853. There were only seven Universities in Australia at the end of the Second World War, the remaining 12 have been established in a period of less than 40 years.

The Colleges of Advanced Education grew out of our state systems of Technical Colleges and Teachers' Colleges and received their major impetus in the 1960s. The Colleges reached a peak of over 70 in the late 1970s, but were rationalized to the present 45 in the late 1970s.

Levels of education. There are three levels of education and three tiers of Tertiary Education in Australia. Our students spend 12 years at school, six in Primary School and six in Secondary School. There is no Community College system and from Year 12 they go into Tertiary Education. The three tiers of Tertiary Education are:-

Universities. We offer Undergraduate Degree courses of 3-4-5-6 years and Post Graduate Degrees. Research activities are almost wholly confined to Universities. There are no trade or craft type course.

Colleges of Advanced Education. A mixture of Degree and Diploma courses; mainly three year course with some development of four year degrees. Emphasis was originally on technical courses but moving into professional (business management, legal studies) and humanities. Very little research is done although this is now developing. Major emphasis is on specific vocational skills. There is however some overlap with Universities e.g. Law.

Technical and Further Education. This is the "hands on" and "how to do it" tier with emphasis on trade and craft courses for the young and on further education and short courses for the general community. A significant provision of "quality of life" courses rather than professional studies.

Student residential. The emphasis on students in residence, on campus, is very much lower in Australia than USA. Students are less mobile and tend to remain in their own State and are therefore more likely to remain at home while completing their course. While more students are leaving home during their period in higher education, they tend to live in non-Collegiate residences, group together to lease houses or board with a family near the campus.

It is unusual in a metropolitan or city University to find more than one sixth of the enrolled students in University residences. The proportion will be higher in Universities away from the major cities, but Colleges of Advanced Education provide little student accommodation.

Liberal arts versus traditional institutions. Amongst Universities, the older institutions tend to be traditional in type, providing a full range of courses from Humanities to Professional. The very new institutions tend to be more like a liberal Arts college, offering Arts, General Sciences, Commerce, Business Administration and the like. As a consequence, the very new institutions have less academic and internal strength, are less likely to attract the best students and their long-term viability could be questioned. Certainly some rationalization between newer Universities and Colleges of Advanced Education has already been made.

Tenure. A major difference is in the tenure arrangements for academic staff. In Australia academic staff are in the main appointed to a continuing position, i.e. there is no expressed period or term to their appointment. Unless they decide to leave or are dismissed (an unusual occurrrence) their appointments are deemed to be for their working life. As a consequence many University departments are top heavy with staff nearing retirement, and promotion (or even appointment) is very difficult for the young academic. It has produced a concerning stagnation within institutions, making it very difficult to innovate.

Organization and structure.

The characteristic that distinguishes most institutions is that few if any, seem to operate quite the same way. This is equally true in Australia where history and personalities are reflected in hierarchical structures. For example there is not a single Director of Physical Plant nor Vice President for Facilities Management to be found anywhere. In Queensland the three facilities managers are variously described as Controller, Buildings and Grounds, Site and Buildings Manager, and Director, Buildings and Grounds, and it's no different elsewhere.

The organizational structure and hierarchy of a typical university (Univsity of Queensland) is shown attached as Appendix 3. Titles vary as does span of control. The term Vice Principal is sometimes used instead of Deputy Vice-Chancellor to connote a purely administrative appointment. The Registrar appointment is tending to become more that of Secretary heading up the Secretariat. Many of these appointments are traditionally those found in English universities and it's true that the older universities such as Melbourne and Sydney are still close to the "Oxbridge" model.

The Director, Buildings and Grounds, or whatever, fairly typically will answer to a Deputy Vice-Chancellor or Vice Principal. The responsibilities of the appointment usually run to Site Planning, Development, Operations and Maintenance.

The pluses and minuses are Security, Traffic and Parking, Allocations of Space and Space Inventory. Security was upgraded during the student unrest of the 1970s and still tends to be directed at a higher level. The organization of the Buildings and Property Branch, University of Melbourne is attached as Appendix 4. The traditional functional split between Design and Construction and that between Construction and Maintenance has been all but eliminated. Most Buildings Branches have total responsibility for the whole facilities process as part of a life cycle approach to management. In this process the title of University Architect and that function has all but disappeared.

Salary levels in Australian universities tend to be fairly standard. (It's all part of the Comparative Wage Justice syndrome.) Indeed, most are set by tribunals. In some cases senior administrative salaries are academically aligned but the tendency is to break that nexus and set independent sscales for administrators.

	$ p.a.	
Vice-Chancellor	74,558	
Deputy Vice-Chancellor	64,132	
Professor	54,948	(Head of Buildings Branch ($49-52,000 p.a.)
Reader (Associate Professor)	46,397	
Senior Lecturer	41,029	(Second level professional staff (Buildings Branch $38,000 p.a.)
Lecturer	34,467	
		(Third level staff (Buildings Branch $30,000 p.a.)

All senior appointments attract superannuation with the current scheme Staff Superannuation Australian Universities (SSAU). A contributor pays 7 percent of gross salary to which is added double i.e. 14 percent paid by the University into a pooled investment scheme. Retirement is usually at 65 yrs with options at 60 yrs.

Contracted senior appointments are rare but increasing. Most academics enjoy tenure and implicitly senior administrators are seen to be permanent employees. But times they are achanging!

CURRENT PROBLEMS AND TRENDS IN FACILITIES MANAGEMENT.

This section of the paper will outline the current problems under investigation and trends emerging in Facilities Management.

Terminology and standardization of terms. A major problem has been the lack of standard terminology in Facilities Management, particularly in maintenance. A very significant step to overcome this problem has been the publication of a booklet entitled "Standard Terminology for Building Maintenance in Australia". This was the work of a group, called the Facilities Management Sub-Committee of the National Committee for Rationalized Building (NCRB).

This involves members from CSIRO (previously mentioned), the major government construction and works authorities, and the Universities (including the authors of this paper). This publication has now been published and distributed throughout maintenance organizations in Australia.

Life cycle costs. The definition adopted by the National Committee on Rationalized Building on the advice of its Facilities Management Sub-Committee is "The total cost of an item throughout its life including planning, design, acquisition and support costs. Note: Support costs include maintenance, operating costs and other costs directly attributable to owning or using the item." It is the major topic to which the Facilities Management Sub-Committee has addressed itself for the past few years.

The two aspects of this very broad topic which have been the Sub-Committee's major initial focus of attention are:- Asset Definition and Registration and a national system for building life cycle cost performance data recording. Attached as Appendix 4 are details of A System Recommended for Use in Australia for recording life cycle cost data.

Clearly a sound theoretical basis is needed to enable data requirements to be defined and relevant information collected and processed in order to produce meaningful measures of life cycle cost performance and interpretation of these measures.

Asset Registration (an asset being an item worthy of identification as a discrete entity) is a problem integral with but different from the building elements identified in the recommended costs matrix. What is involved here is a methodology that can uniquely catalogue not simply separate facility components of buildings e.g. Air Conditioning, but the items which are themselves the discrete units of these components e.g. Air Conditioning-Compressor. It represents nothing more than progressive refinement of the cataloguing or classification system.

Most facilities managers will be aware of the Federal Supply Classification System (FSC) (sometimes called the NATO Supply Classification System (NSC)). A good deal of work has been done in Australia adapting the FSC/NSC Cataloguing or Codification System to a more industry (as opposed to Defence) orientation. The result called AUSLANG (The Australian Supply Language) now has wide application with the mining and extractive industries. A sub set of the Auslang Dictionary of Item Names was produced for that industry called Mining Item Name Dictionary (MIND). NCRB themselves initiated a project to adapt the Auslang Dictionary of Item Names (ADIN) for the codification of building products and materials, the aim of which was to produce a foundation for a common technical language throughout the Building and Construction Industry.

A rough cut version has been produced calling Building Item Name Dictionary (BIND). What is now being investigated by the joint authors in the name of the Facilities Management Sub Committee (of NCRB) of which both are members, is the application of BIND as an Asset Registration system.

What comes out of ADIN, as indeed for FSC/NSC, is a unique identifier e.g. 4120-66-123-4567 = Air Conditioning Equipment - Australia - Identifier. The attraction of such a system is apparent in that if adopted it will provide not only a common supply language but a means of specific asset registration which being built around standard item names could literally be universal. BIND currently runs to 8039 item names which when cross referenced gives around 15,000 distinct catalogue items.

Computerization. Most trends in Australia usually lag behind the USA although of course there are exceptions. Computerization of Facilities Management is following this pattern, although we are working very hard in an attempt to catch up. We are now developing and investigating the use of computers in:-

1. Works Management and Information Systems
2. Preventive and Programmed Maintenance
3. Central Control and Management Systems (CCMS/ECMS)
4. Risk Management
5. Inventory Control and Management.

A major controversy is whether mainframe computers or dentralized minis or micros under the control of the Facilities Manager should be used. Should software be purchased or developed in-house? A major investigation has been proceeding into the applicability of an English developed hospital system - WIMS (Works Information and Management System).

These moves demand the use of common terminology, common charts of accounts, and common coding and cataloguing of inventories. Terminology has already been mentioned. The APPA Chart of Accounts has been the basis of an Australian system of accounting developed by the same Committee mentioned under Terminology.

Energy management. Australia has quite limited liquid fossil fuel reserves but almost unlimited solid fossil fuel reserves. It is in fact a major exporter of steaming and coking coal. At present usage rates the black coal reserve is 500 years and the brown coal reserve at least double. Something in excess of 90 percent of the country's electricity is produced in coal fired power stations. Hydro electric generation covers only peak loads in NSW and Victoria although Tasmania is heavily serviced with hydro sourced power. All new stations are coal fired and none nuclear (nor perhaps likely to be). Natural gas is still a very minor source of energy. The thrust of energy management is therefore cost and not resources and all strategies are targetted to this end.

All power in Australia is produced by government owned monopolies (qangos) usually a State Electricity Commission, each with its own tariffs and pricing policies. With a wide range of tariffs available the initial source of saving can be to convert to a more favourable tariff structure.

In general terms both air conditioning and central heating are much less in evidence in Australia than North America. This is in part due to the milder range of temperature and in part to capital costs. However most modern office accommodation (say less than 10 years old) will provide air conditioning. It still remains the major target for energy managers and conditions of 26°C (79°F) summer and 18°C (64°F) winter are the norm. More use of ambient outside air and enthalpy control is now being made. Systems that use chilled water or ice storage are very rare indeed.

The application of computer based Central Control and Monitoring Systems is all but universal in modern hi-rise *office buildings. Applications to* systems comprising large numbers of buildings such as universities is not widespread, but is growing. The few that have gone totally for these systems, particularly the major proprietary brands have generally regretted so doing. Of the 19 universities only 5 have anything like a full system operating and of these only 2 run successfully. There is simply not the range of hardware, expertise, service and spare parts available as in USA. None the less new systems are appearing commercially and the so-called "intelligent" building being built.

Lighting systems and levels also provide opportunities for energy managers. Most institutions are guided by the Standards Association of Australia (SAA) Code of Practice for Interior Lighting and The Visual Environment AS 1680-1976. (N.B. There are literally hundreds of Australian Standards published by SAA. Most are persuasive in practice.)

Power is usually bought on a Demand Tariff. It is not "time of day" although there is a ratchet clause. The University of Queensland (High Voltage Supply-Demand Tariff) charge is $13.93 (Aust) per kW integrated over a 30 minute period plus 2.79 cents (Aust) per kWh. Cogeneration is just not on. The aim in designing new office type buildings is to achieve an all up power consumption rate of 400-450 MJ/m^2/Annum (N.B. 1 MJ/m^2 = 2.989 kW/ft^2). Energy Management is and will remain a major concern of the efficient Facilities Manager and all major universities have full time professional staff working on this.

Health and safety. This is a new and growing problem area in Facilities Management. Pressure for change and improvements comes from:-

a. Statutory requirements. New Acts of Parliament, based on a 1974 British Act, are being issued in each State, imposing greater standards of care and responsibility on employers.

b. Trade Union demands. Trade Unions have much greater political influence in Australia than the USA. As they become stronger and more militant, requirements for greater safety, for more involvement by their members in establishing policy and standards are emerging.

c. Problems of unacceptable materials. Asbestos, PCBs and toxic wastes are just as great a problem as they are in the USA.

Statutory controls. Building Regulations, Fire and Safety Controls are a state matter in Australia, although recent trends are to move to an Australian Uniform Code. The Standards Association of Australia also influences requirements on building owners in many areas, as their standards are adopted as persuasive by governments and semi-Government authorities. The impact of these developments means the diversion of resources to:-

a. Fire detection and prevention;
b. Removal or sealing of Asbestos;
c. Escape from buildings (smoke barriers, escape stairs etc.);
d. Emergency lighting;
e. Control of Fumes - cupboards and exhaust systems;
f. Improving storage and disposal arrangements for flammable and contaminated materials.

Financial constraints and its effects. We all compete for resources that are becoming scarcer. Our problem is to win the funding arguments that recognize that facilities cost money to operate, maintain, rehabilitate and replace. It is not our aim to go over the ground already well walked by people like Harvey A. Kaiser of Syracuse University. All we wish to do here is to discuss the ways in which these problems manifest themselves in Australia and what if anything is being done about them.

It needs to be appreciated that the entire national university system represents considerably less than many American state systems. Moreover no two institutions are organized or managed the same way. Indeed it is a misnomer to talk of a national system at all. In reality what exists are 19 institutions totally different one from the other each competing for a share of the public purse.

An attempt has been made in recent years by the joint authors to exchange facilities cost information largely based on the APPA format with partial success. But what has given this recent additional thrust is that the Australian Vice-Chancellors' Committee (AVCC) have now become collectively aware of the growing problems of inadequate facilities funding. A national Working Party has been established under the aegis of the AVCC (of which the joint authors are members) to quantify this problem.

It goes to the perennial problems of Deferred Maintenance and Capital Renewal (= Rehabilitation) and Replacement. The initial surveys have uncovered widely variable systems and standards of facilities accounting and recording, sadly including little or none. The combination of ageing and statutory pressures (under the Occupational Health and Safety mantle) have predictably created substantial demands for "catch up" funds.

That analysis is continuing with efforts being made to refine the acquired data base to extract life cycle cost performance data for specific classifications of buildings. To what extent the AVCC will be successful in convincing the Federal Government that "tied" grants need to be made into these under funded areas is a matter for conjecture. But it is hard to avoid the view that the universities themselves will be told to better manage their own recurrent resources to take account of these factors. OK so what's new - back to the war!

Mechanization of cleaning. One area of little apparent development in Australia is mechanization of custodial activites. Our janitors (cleaners) use the old methods - brook, mop, bucket and vacuum cleaner. The very high labour content of cleaning (well over 90 percent) demands management attention to means by which productivity can be improved. Arguments that go to Contract as opposed to In House cleaning are as partisan in Australia as elsewhere, but on the evidence available Contract wins easily in cost terms. Most universities clean in house although the painful and tedious conversion to contract is happening. Training and management are however finally inhibited by the limited impact technology (in terms of machines and chemicals) has made in this substantial cost centre or are we just not with it?

WHAT ARE WE DOING TO HELP OURSELVES?

We are a very small group of Facilities Managers in Australia (19 Universsities and 45 Colleges - not all with professionally qualified or trained officers). What are we doing to help ourselves?

Seek advice and information. Some of us are members of APPA and SCUP. There are some British organizations who also provide similar material through publishing newsletters. Thankyou to Henry Kaiser and those many other talented APPA members and their publications. The authors are fairly regular visitors to USA and have received unstinting assistance from APPA colleagues. Much of that material is finding its way into other institutions. The "word" is spreading.

The Facilities Management Sub-Committee of the National Committee for Rationalized Building (NCRB). The NCRB (an organization created by the major government and statutory authority construction groups) established a Facilities Management Group some ten years ago. This Committee (which includes the two authors of this paper) is working in the areas of:-

a. Terminology standardization (already mentioned).
b. A national system for building Life-Cycle Cost performance data recording.
c. Asset Registration (including coding and name dictionaries).
d. Computerization in Facilities Management.
e. Health and safety.
f. Energy Management.

The Australian Universities' Energy and Maintenance Management Biennial Conference. Every two years the 19 University Facilities Managers and senior staff meet in a major conference to exchange information, ideas and systems. This was introduced as an initiative by the joint authors based on their experiences in USA on earlier visits.

The Australian Vice-Chancellors' Committee (AVCC) Working Group on Building Maintenance, Rehabilitation and Replacement. The AVCC has established this group and surveys are proceeding into historical data on Maintenance and Rehabilitation costs, but are severely hampered by lack of a common data base. The authors are members of this group and part of their mission in the USA is to study how large systems establish priorities, standards and allocate funding for Maintenance, Rehabilitation and Replacement.

ASK NOT WHAT YOU CAN DO FOR APPA BUT!

As indicated we fully realize our shortcomings and deficiencies. This great organization comprising members from 2,800 Institutions of Higher Education has:-

a. Lengthy experience
b. Data banks
c. Systems information
d. The experience of having tried, failed and succeeded, so why reinvent the wheel?
e. Many kind people of considerable talent.

We therefore continue to seek your help and advice about:-

(a) Information and details of space planning criteria, funds allocation and priority criteria, systems control. We plan this time to visit the University of California System and the University of Texas System. Can others provide similar advice please?

(b) Come and see us - SOON! Australia appears a long way away, but it's your turn and besides the way your dollar is going it's damn near free.

We have:-

- A great country
- Space
- Beautiful scenery
- Unusual animals
- A fondness for America and Americans

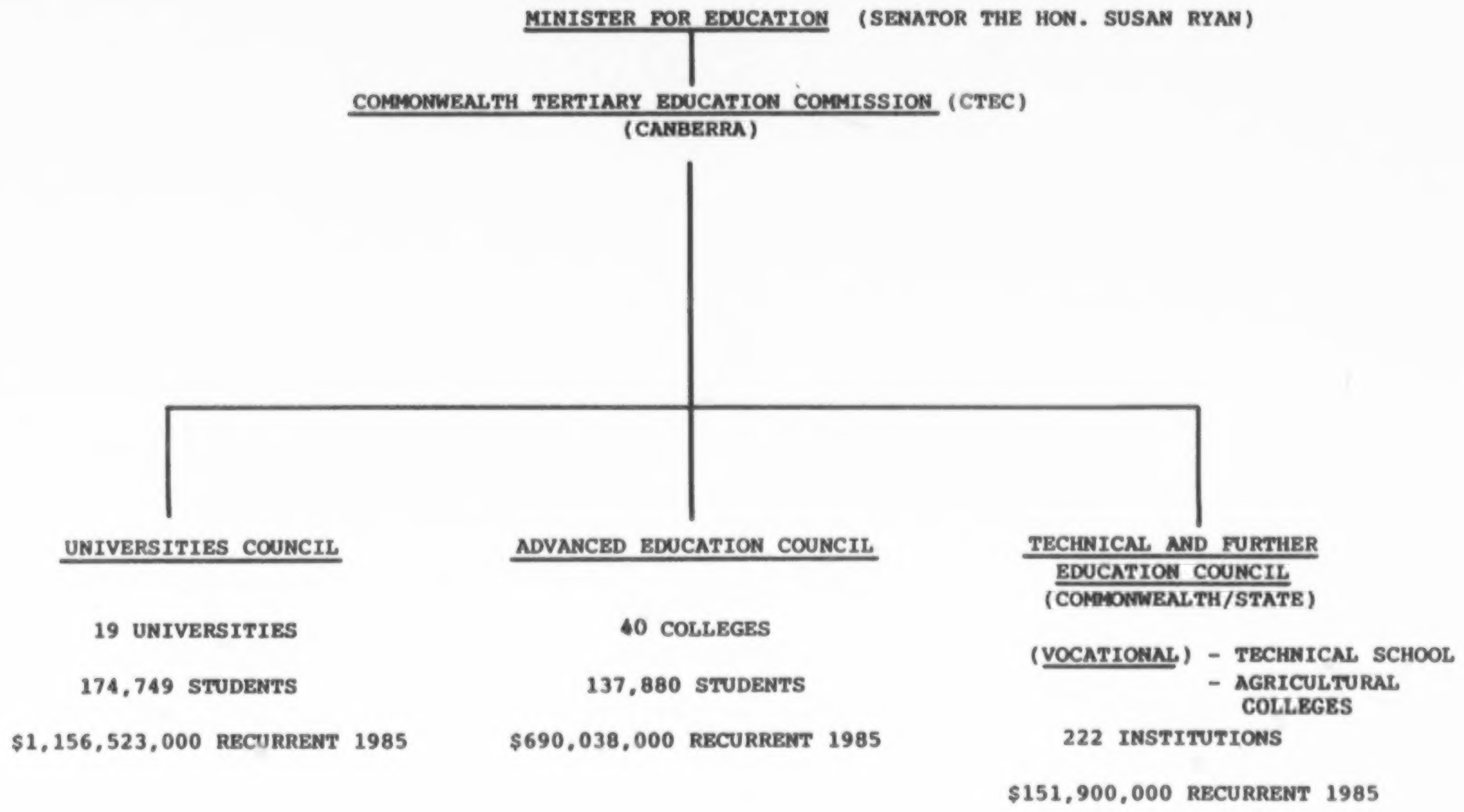
and . The Americas Cup - or is it now called the Australia Cup?

So come and give us your friendship and advice. You will be most welcome, besides the beer is much better. Have a "Fosters" instead!

Attachments:

Appendix 1 - Tertiary Education Structure in Australia
Appendix 2 - Extract of CTEC Report 1984 - Student Load by level of course.
Appendix 3 - Outline Organization and Hierarchy of the University of Queensland.
Appendix 4 - Organization of the Buildings and Grounds Branch, University of Queensland.
Appendix 5 - Building Life Cycle Cost Performance Data Recording - A System Recommended for Use in Australia.

APPENDIX 1.



MINISTER FOR EDUCATION (SENATOR THE HON. SUSAN RYAN)

COMMONWEALTH TERTIARY EDUCATION COMMISSION (CTEC)
(CANBERRA)

UNIVERSITIES COUNCIL

19 UNIVERSITIES

174,749 STUDENTS

$1,156,523,000 RECURRENT 1985

ADVANCED EDUCATION COUNCIL

40 COLLEGES

137,880 STUDENTS

$690,038,000 RECURRENT 1985

TECHNICAL AND FURTHER EDUCATION COUNCIL
(COMMONWEALTH/STATE)

(**VOCATIONAL**) - TECHNICAL SCHOOL
- AGRICULTURAL COLLEGES

222 INSTITUTIONS

$151,900,000 RECURRENT 1985

APPENDIX 2

STUDENT LOAD BY LEVEL OF COURSE, BY UNIVERSITY, 1984
(EFTSU) (EQUIVALENT FULL TIME STUDENT UNITS)

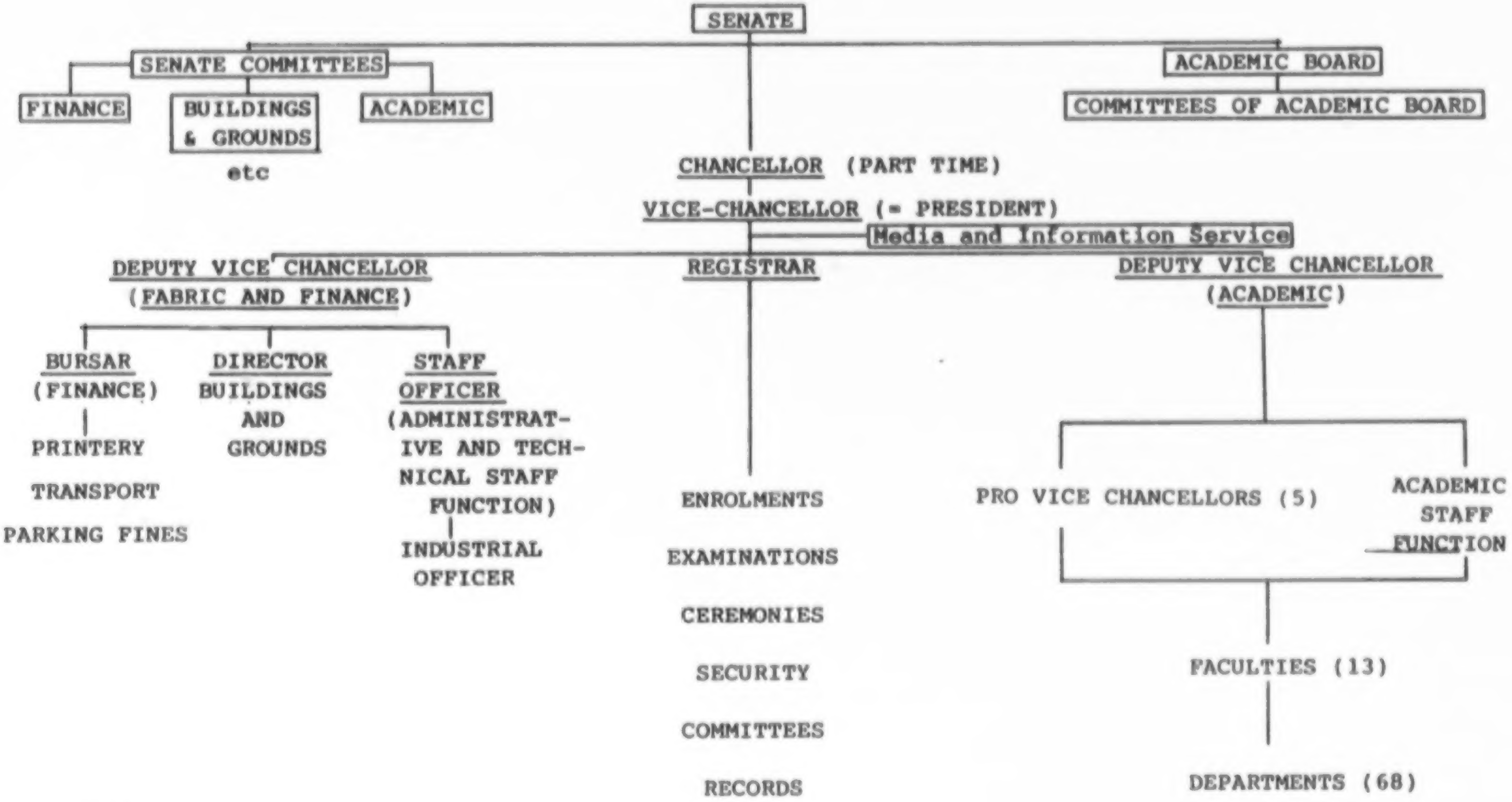
University	Higher Degree 1984	Undergraduate 1984	Total 1984	Ranking (By EFTSU)
Sydney	2,409	13,796	16,205	1
New South Wales	1,736	12,497	14,233	2
New England	648	4,512	5,160	10
Newcastle	355	3,435	3,790	14
Macquarie	848	6,452	7,300	8
Wollongong	229	4,342	4,571	12
NEW SOUTH WALES	6,225	45,034	51,259	
Melbourne	1,660	11,871	13,531	4
Monash	1,480	10,188	11,668	5
La Trobe	576	6,610	7,186	9
Deakin	256	3,164	3,420	16
VICTORIA	3,972	31,834	35,805	
Queensland	1,396	12,713	14,109	3
James Cook	230	2,395	2,625	17
Griffith	184	2,341	2,525	18
QUEENSLAND	1,810	17,449	19,259	
Western Australia	903	7,116	8,019	6
Murdoch	225	1,931	2,157	19
WESTERN AUSTRALIA	1,128	9,047	10,175	
Adelaide	779	6,630	7,409	7
Flinders	275	3,149	3,424	15
SOUTH AUSTRALIA	1,054	9,779	10,833	
Tasmania	454	3,631	4,085	13
Australian National	795	4,300	5,095	11
TOTAL AUSTRALIA	15,436	121,076	136,511	

FACILITIES MANAGEMENT DOWN UNDER

APPENDIX 3.

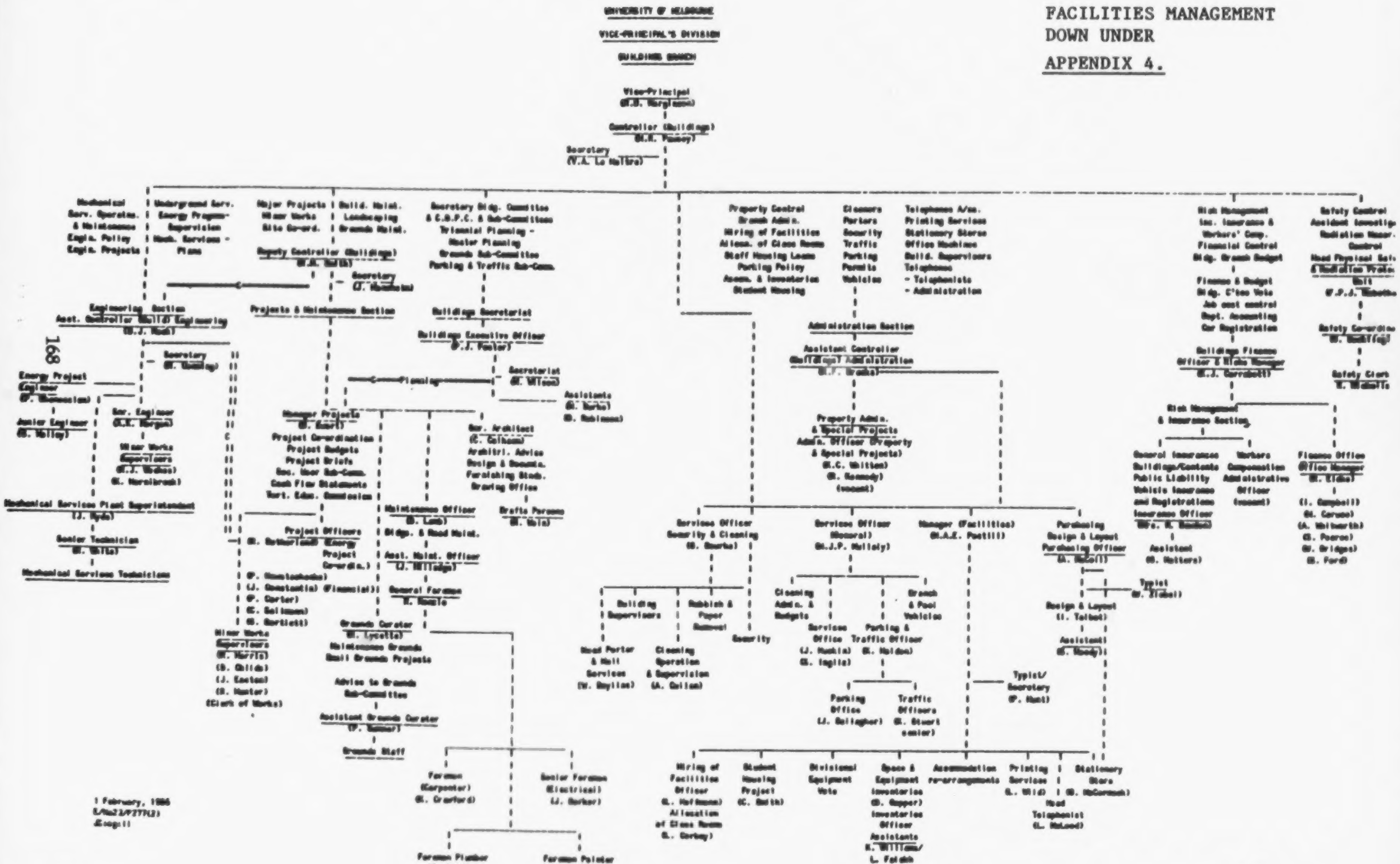
OUTLINE ORGANIZATION AND HIERARCHY OF THE UNIVERSITY OF QUEENSLAND

(N.B. SCHEMATIC FOR ILLUSTRATIVE PURPOSES ONLY).


SENATE
SENATE COMMITTEES
FINANCE
BUILDINGS & GROUNDS
ACADEMIC
etc
ACADEMIC BOARD
COMMITTEES OF ACADEMIC BOARD
CHANCELLOR (PART TIME)
VICE-CHANCELLOR (= PRESIDENT)
Media and Information Service
DEPUTY VICE CHANCELLOR (FABRIC AND FINANCE)
REGISTRAR
DEPUTY VICE CHANCELLOR (ACADEMIC)
BURSAR (FINANCE)
PRINTERY
TRANSPORT
PARKING FINES
DIRECTOR BUILDINGS AND GROUNDS
STAFF OFFICER (ADMINISTRATIVE AND TECHNICAL STAFF FUNCTION)
INDUSTRIAL OFFICER
ENROLMENTS
EXAMINATIONS
CEREMONIES
SECURITY
COMMITTEES
RECORDS
PRO VICE CHANCELLORS (5)
ACADEMIC STAFF FUNCTION
FACULTIES (13)
DEPARTMENTS (68)

FACILITIES MANAGEMENT
DOWN UNDER

APPENDIX 4.


UNIVERSITY OF MELBOURNE
VICE-PRINCIPAL'S DIVISION
BUILDINGS BRANCH
Vice-Principal
Controller (Buildings)
Secretary
(V.A. Le Maitre)
Mechanical Serv. Operatns. & Maintenance Engin. Policy Engin. Projects
Underground Serv. Energy Program-Supervision Mech. Services - Plans
Major Projects Minor Works Site Co-ord.
Build. Maint. Landscaping Grounds Maint.
Secretary Bldg. Committee & C.B.P.C. & Sub-Committees Triennial Planning - Master Planning Grounds Sub-Committee Parking & Traffic Sub-Comm.
Property Control Branch Admin. Hiring of Facilities Allocn. of Class Rooms Staff Housing Loans Parking Policy Accom. & Inventories Student Housing
Cleaners Porters Security Traffic Parking Permits Vehicles
Telephones A/cs. Printing Services Stationery Stores Office Machines Build. Supervisors Telephones - Telephonists - Administration
Risk Management inc. Insurance & Workers' Comp. Financial Control Bldg. Branch Budget
Finance & Budget Bldg. C'tee Vote Job cost control Dept. Accounting Car Registration
Buildings Finance Officer & Risks Manager
Safety Control Accident Investig. Radiation Hazar. Control
Head Physical Safe & Radiation Protec. Unit
Safety Co-ordina
Safety Clerk
Deputy Controller (Buildings)
Secretary
Engineering Section
Asst. Controller (Build.) Engineering
Secretary
Energy Project Engineer
Junior Engineer
Snr. Engineer
Minor Works Supervisors
Mechanical Services Plant Superintendent
(J. Hyde)
Senior Technician
Mechanical Services Technicians
Projects & Maintenance Section
Buildings Secretariat
Buildings Executive Officer
Secretariat
Assistants
(D. Robinson)
Planning
Manager Projects
Project Co-ordination Project Budgets Project Briefs Sec. User Sub-Comm. Cash Flow Statements Tert. Educ. Commission
Snr. Architect
Architrl. Advice Design & Documtn. Furnishing Stds. Drawing Office
Drafts Person
Project Officers
(Energy Project Co-ordin.)
(P. Carter)
(Financial)
Maintenance Officer
Bldgs. & Road Maint.
Asst. Maint. Officer
General Foreman
Grounds Curator
Maintenance Grounds Small Grounds Projects
Advice to Grounds Sub-Committee
Assistant Grounds Curator
Grounds Staff
Minor Works Supervisors
(J. Easton)
(R. Hunter)
(Clerk of Works)
Foreman (Carpenter)
Senior Foreman (Electrical)
Foreman Plumber
Foreman Painter
Administration Section
Assistant Controller (Buildings) Administration
Property Admin. & Special Projects
Admin. Officer (Property & Special Projects)
(vacant)
Services Officer Security & Cleaning
Building Supervisors
Rubbish & Paper Removal
Security
Head Porter & Mail Services
(W. Bayliss)
Cleaning Operation & Supervision
(A. Cullen)
Services Officer (General)
Cleaning Admin. & Budgets
Services Office
Parking & Traffic Officer
Branch & Pool Vehicles
Parking Office
(J. Gallagher)
Traffic Officers
(senior)
Manager (Facilities)
Typist/ Secretary
(P. Hunt)
Purchasing Design & Layout
Purchasing Officer
Typist
Design & Layout
(I. Talbot)
Assistant
Hiring of Facilities Officer
Allocation of Class Rooms
Student Housing Project
(C. Smith)
Divisional Equipment Vote
Space & Equipment Inventories
Inventories Officer Assistants
Accommodation re-arrangements
Printing Services
Head Telephonist
(L. McLeod)
Stationery Store
Risk Management & Insurance Section
General Insurance Buildings/Contents Public Liability Vehicle Insurance and Registrations
Insurance Officer
Assistant
Workers Compensation Administrative Officer (vacant)
Finance Office
Office Manager
(I. Campbell)
(A. Whitworth)
(S. Pearce)
(B. Ford)
1 February, 1986

BEST COPY AVAILABLE

APPENDIX 5.

BUILDING LIFE CYCLE COST PERFORMANCE DATA RECORDING

A SYSTEM RECOMMENDED FOR USE IN AUSTRALIA

The first problem we have addressed is how to relate systematically the costs incurred over the life of any facility to the principal factors known to contribute to cost generation. This is necessary to enable the interpretation of experience in terms of the management of the facility and the feed-back desired to improve the design of new or reconstructed facilities.

The second problem we have addressed is how to do so in a way which could provide, so far as practicable, a system which could be used generally by facility owners and managers throughout the country without violation of their legitimate differences in emphasis of type and detail of information which they perceive appropriate. By this method a much wider pool of information can be made available than could come from within a range of independent but incompatible systems.

Thus the costs arising from the procurement and use of constructed facilities need to be related to seven groups of factors:

- the cost-generating activities which take place on the facility over its life (e.g. initial procurement, support functions such as maintenance, cleaning);
- the physical components of the facility (e.g. fabric, sub-structure, window, chiller);
- the resources used in undertaking the activities (e.g. materials, direct labour);
- the materials and other construction characteristics of components (e.g. steel frame, acrylic painted internal wall);
- the type of use for the facility or principal part thereof (e.g. hospital, ward wing, boiler house);
- the standard of quality of the facility; and
- other factors (e.g. location, size, age, user expectations, intensity of use).

Basic Matrix

The sets of activities and physical components together form what is believed to be an appropriate basic matrix for allocation of costs. This matrix is hierarchical in its structure, and provides the necessary means for ensuring consistency between different users who may use it at different levels of detail. This outline is capable of extension into more detail where desired, provided that detail is maintained consistent with the framework now proposed. The system also provides ready means for relating support costs at any level of detail to the initial capital cost of the item, as capital costs should be available at the same level of detail through the use of the same elemental break-down.

The items of particular significance in defining physical components and activities for life cycle performance purposes depend on the broad type of use. In housing, for example, a limited number of items such as external and internal paintwork, plumbing, electrical, stumps and roofs, vandalism and vacancy repairs could be appropriate. For schools, additional categories such as security require consideration. Specialist buildings require unique sets of categories which may not be necessary for other types of building use. There are limits to the extent to which any standard classification can adequately cover all the needs for all types of buildings. It remains highly desirable however to seek as much basic commonality as practicable.

Breakdown of resources used (materials, labour etc.) can be catered for by adding a third dimension to the matrix, as described previously.

The factors above are now discussed in further detail.

Activities

The cost-generating activities which take place in relation to a facility, or part thereof, over its life can usefully be considered under the three sub-divisions of initial procurement, on-going support and disposal. (As the subject matter is concerned with the costs which arise from directly facility-related activities, the costs of other activities which take place within the facility, for example nursing and medical staff and medical equipment in a hospital, are excluded from consideration.) Each of these has been subdivided in turn. Support activities have been subdivided into maintenance, operation, reconstruction and other activities, and each of these is capable of further subdivision.

The resulting four-level hierarchy considered appropriate as a working basis for most purposes is shown in Figures 9a and 9b. This is capable of further subdivision into more detail where desired, provided that the framework is maintained.

Facility Components

On the whole, it seems to be reasonable to take the National Public Works Conference (NPWC). Standard Elements and Sub-elements as a basis for classifying facility components, making changes where the standard is not adequately covering real needs. Adoption of this classification would increase consistency and coordination among NPWC member departments and other bodies which already use the standard for other purposes. While the NPWC structure is not ideally suited to life cycle performance purposes as it stands, it can be used as a basis with some modification without undue violence to its concepts; for example, external and internal wall finishes need to be distinguished.

A hierarchical subdivision of the facility into physical components is shown in Figures 10a and 10b. This makes use of the NPWC element group, element, sub-element and sub-element division categories. Further subdivision can be made provided that the framework is maintained and the NPWC sub-elements and divisions are used as far as practicable.

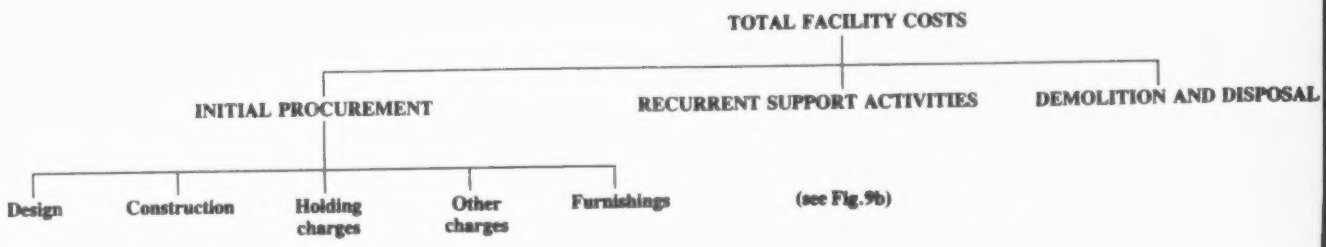

TOTAL FACILITY COSTS
INITIAL PROCUREMENT
RECURRENT SUPPORT ACTIVITIES
DEMOLITION AND DISPOSAL
Design
Construction
Holding charges
Other charges
Furnishings
(see Fig.9b)

Figure 9a. Outline of initial procurement and recurrent support activity cost categories recommended for use in Australia.

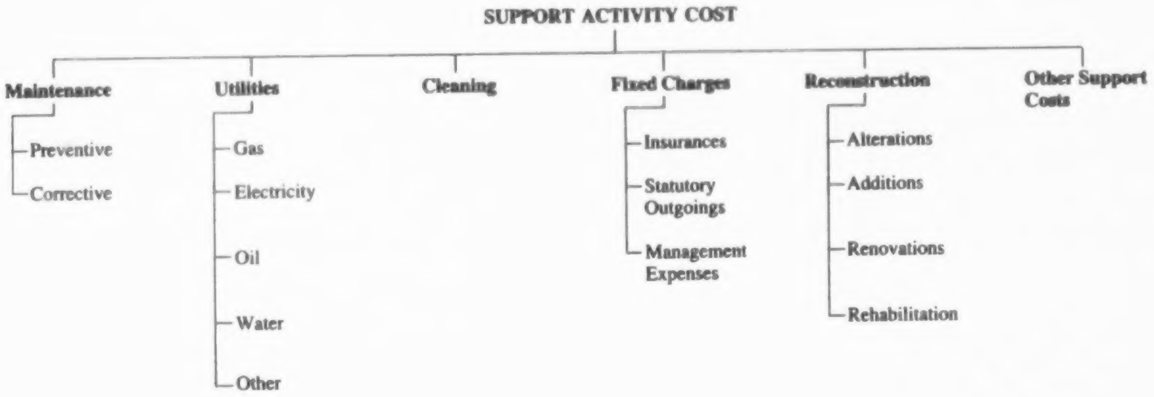

SUPPORT ACTIVITY COST
Maintenance
Preventive
Corrective
Utilities
Gas
Electricity
Oil
Water
Other
Cleaning
Fixed Charges
Insurances
Statutory Outgoings
Management Expenses
Reconstruction
Alterations
Additions
Renovations
Rehabilitation
Other Support Costs

Figure 9b. Outline of support activity cost categories recommended for use in Australia.

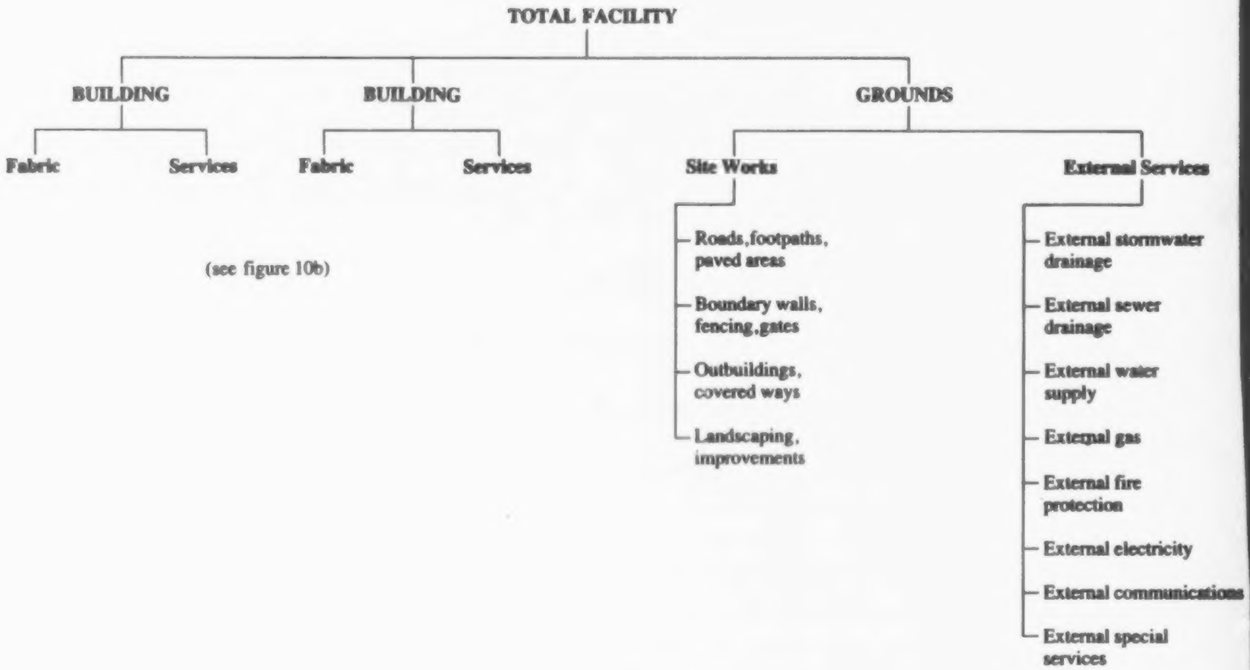

TOTAL FACILITY
BUILDING
BUILDING
GROUNDS
Fabric
Services
Fabric
Services
Site Works
External Services
(see figure 10b)
Roads, footpaths, paved areas
Boundary walls, fencing, gates
Outbuildings, covered ways
Landscaping, improvements
External stormwater drainage
External sewer drainage
External water supply
External gas
External fire protection
External electricity
External communications
External special services

Figure 10a. Outline of facility components recommended for use in Australia — total facility including grounds. (Element group, elements and sub-elements only shown. Sub-element divisions follow NPWC practice).

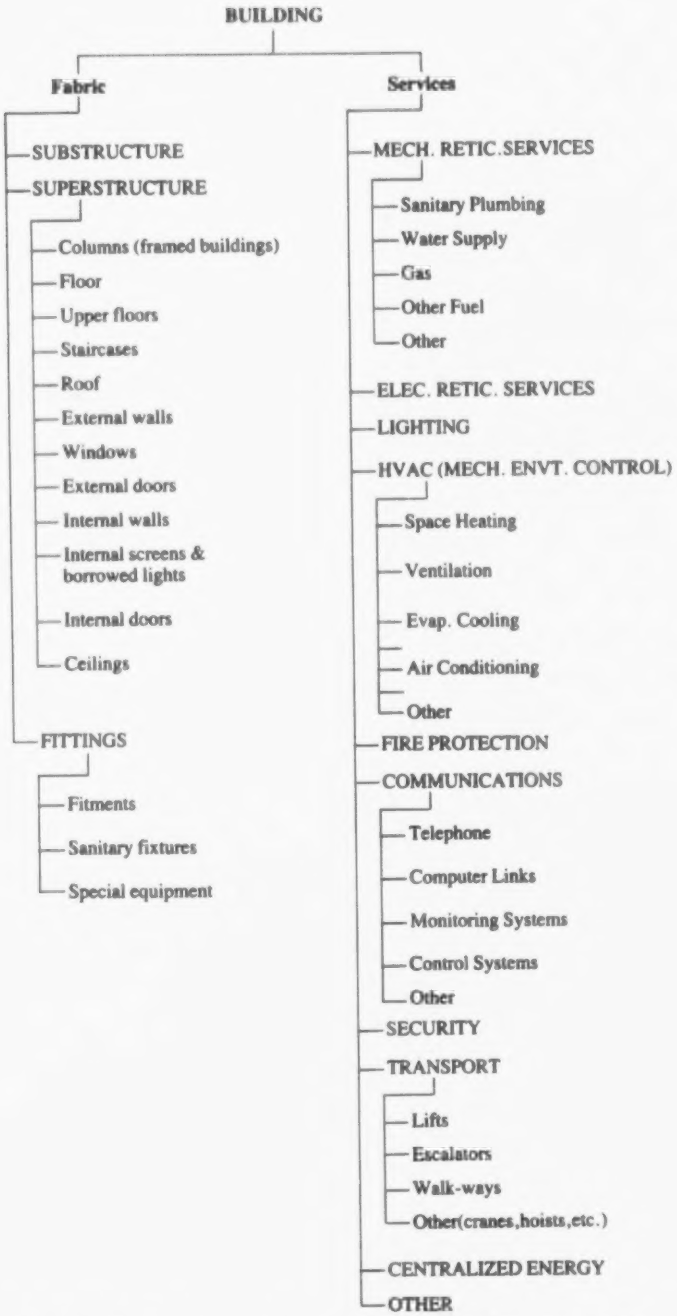

BUILDING
Fabric
Services
SUBSTRUCTURE
SUPERSTRUCTURE
Columns (framed buildings)
Floor
Upper floors
Staircases
Roof
External walls
Windows
External doors
Internal walls
Internal screens & borrowed lights
Internal doors
Ceilings
FITTINGS
Fitments
Sanitary fixtures
Special equipment
MECH. RETIC.SERVICES
Sanitary Plumbing
Water Supply
Gas
Other Fuel
Other
ELEC. RETIC. SERVICES
LIGHTING
HVAC (MECH. ENVT. CONTROL)
Space Heating
Ventilation
Evap. Cooling
Air Conditioning
Other
FIRE PROTECTION
COMMUNICATIONS
Telephone
Computer Links
Monitoring Systems
Control Systems
Other
SECURITY
TRANSPORT
Lifts
Escalators
Walk-ways
Other(cranes,hoists,etc.)
CENTRALIZED ENERGY
OTHER

Figure 10b. Outline of facility components recommended for use in Australia — building. (Element group, elements and sub-elements only shown. Sub-element divisions follow NPWC practice).

Functional Spaces

The basis for the facility component classification recommended in this paper remains the elements of structure, services etc. However, information is often needed on the basis of functional spaces, for example the costs of maintaining and operating offices, lecture theatres, laboratories, canteens, car parking and so on.
The NPWC provides a list of relevant spaces for schools, colleges and hospitals which should be the basis for standard functional space terminology.

Specific functional spaces relevant to any user may be used as sub-divisions of the elements listed:
e.g. Floors — office
— lecture theatre
— laboratory
— car parking
— etc.

Resources

Resources are required for all activities creating or supporting a facility. Their nature and extent need to be monitored for management purposes, and we propose subdivision into the following classes:

- internal labour costs including direct on-costs, payroll taxes, superannuation payments and holiday pay loadings include:
  - — costs of trade labour directly employed on the work;
  - — costs of supervisory staff, where these can be separately identified as related directly to the work involved;
  - — costs of internal professional staff involved in design or preparation of specifications for the particular projects; and
  - — costs of clerical, stenographic and other service staff directly involved;

- materials taken directly from stock for use on a specific project;
- fees for consultants employed for design or supervision;
- external contractors (including labour contracts); and
- materials purchased externally for a specific project.

In cases where specific trade activities need to be monitored, the relevant further level of subdivision can be applied to each of the above classes.

Component Materials and Construction

Descriptions of elements etc., their quantities, and initial construction costs should be available from the elemental cost break-downs already recommended by the NPWC.
The format already exists for their addition if the information is not already available, and for any changes resulting from reconstruction.

The format thus provides for the necessary information for converting total initial costs or periodic recurrent costs to costs per unit of facility (e.g. \$/m^2 gross p.a.) and costs per unit of component (e.g. \$/tonne chiller capacity p.a.).

Facility Type

Systems such as APPA and the BOMA Chart of Accounts recognize differences between types of facilities or major components thereof, and these differences should be taken into account in interpretation of costs for life cycle performance purposes.

The NPWC provides a list of standard types of building which should be used at the building level of disaggregation and also, where feasible, at the total facility level.

Facility Quality

A continual problem in interpretation of cost data is how to relate them to the quality of the facility. At present, no adequate quantitative method for defining quality is known. Some research has begun in this field but it will be some time before progress can be reported.

Meanwhile we suggest a subjective 3-level assessment — prestige, average, utilitarian — would be helpful, though crude.

Other Factors

Relevant factors include:

- Owner
- User
- Location
- Date completed
- Size
- Capacity
- Intensity of use
- Other

Cost data must also be relatable to the size of the facility and its components. The most common measure of size is floor area, and other measures are often relevant — e.g. number of occupants in office buildings, beds in hospitals, students in educational establishments.

The NPWC provides for this information with suitable formats.

The location and any other relevant factors defining the environment in which the facility is situated must be defined. These formats should be capable of future modification to include other data.

PLANNING A NEW UNIVERSITY IN AUSTRALIA

S Ragusa
Site and Buildings Manager
Griffith University.

INTRODUCTION

Planning for a new university is a relatively rare occurrence anywhere. In Australia, it's an event which has occurred somewhat less often than might be conveyed by the fact that nineteen universities exist within the country's federally-funded university system.

Since 1970, only two universities have been planned and established in Australia as independent universities. Griffith University is one.

This paper sets out briefly the background of universities in Australia and the events leading to the establishment of Griffith University. The planning parameters for the University's academic and physical structure are outlined. The paper gives an abridged history of the planning, construction and growth and the effects of contraction and review.

GENERAL BACKGROUND

Australia's first university was established in Sydney in 1850. By 1911, there was a university in the capital city of each of the six States. There was then a lull until 1946 when the Australian National University was established in Canberra, the National Capital. In the following thirty years, the number of universities increased to 19, but the six established before the Great War still accounted for half the increase in student numbers between 1946 and 1977, from 28 000 to 158 000. Since 1977, the growth has been strictly confined to the newer universities so that now the student numbers total 172 000. (See Figure 1).

Of the thirteen new universities, only five were planned and established as independent universities: Monash and La Trobe in Victoria; Macquarie in New South Wales; Murdoch in Western Australia, and Griffith in Queensland. The others had begun life as regional colleges of the major metropolitan universities or have been formed by the melding together of institutes of technology and state colleges.

The sixties saw the burgeoning of the education system in Australia, spurred on there as elsewhere by the post-war baby boom. In 1963, the University of Queensland was feeling the pressures of growth in the humanities and social sciences. Consequently, permission was granted for that University to begin planning for the establishment of its second university campus in Brisbane. In 1965, a site of 177 ha (437 acres) of natural bushland was chosen on the south-west slopes of Mount Gravatt, seven miles by road from the Brisbane CBD. Progress was slow and by 1968 only a great Ring Road had been built according to a plan developed by the University of Queensland's architect/planner.

In 1970, the Queensland Government allowed the University of Queensland's commission to lapse and, having decided to establish a separate university, placed the responsibility for the new university with a new Planning Council. In 1971, the State passed the Griffith University Act to create a second autonomous university in Brisbane. The University was named after Sir Samuel Walker Griffith, a former Premier and Chief Justice of Queensland, and first Chief Justice of Australia. Samuel Griffith is credited with having drafted the Australian Constitution.

QUEENSLAND: THE SUNSHINE STATE

Queensland, the second largest of Australia's states, covers 667 000 square miles extending over one-quarter of the Australian continent. It's more than twice the size of Texas, seven times the size of the United Kingdom and five times larger than Japan.

The State stretches 1300 miles from north to south and 900 miles east to west, with a coastline 4600 miles long.

Queensland's population is nearing 2.5 million and is growing at a faster rate than that of any other Australian state. Nearly forty-six (46) percent of the population lives near the State's capital, Brisbane. Other population centres are located mainly along the east coast.

The State covers an immense area of vivid physical contrasts. Dense tropical rainforests and semi-arid deserts, palm fringed coral islands and rugged mineral-rich bushland are all encompassed by the State's extensive borders. The Great Dividing Range runs almost unbroken from north to south separating the fertile coastal strip from the vast inland plains where a single cattle station (or ranch) can extend well over 800 square miles.

Sugarcane and pineapples flourish in the lowlands of the eastern seaboard; apples, grapes and peaches in the temperate southern tablelands. In the west, the outback, lush dairying pastures and broad wheatlands, merge into sparser grasslands supporting huge flocks of sheep.

The coast is protected by the Great Barrier Reef, one of the world's natural wonders, and its warm, sandy beaches are enjoyed by tourists from around the world.

And, of course, there's the unique wildlife: kangaroos, koalas, wombats and wallabies.

Brisbane: A Place in the Sun

The city is a modern city of almost a million people. The city's skyline has changed dramatically in the last ten years and we have shaken off the country town image given us by the southerners of Sydney and Melbourne. The city's sprawl is, after Los Angeles, the second largest municipality in the world and with the growth of satellite cities, now reaches in a fifty mile stretch to the City of the Gold Coast, the fastest growing area in the State. It was this growth rate that influenced the choice of the site for the university, the city's second and the State's third.

GRIFFITH UNIVERSITY

Academic Policy and Organisational Structure

From the beginning, the plan of the University Council was to take the first cohort of students in 1975. The University was to be organised into Schools of study defined by a particular academic theme. The Schools were to be the primary bases for the teaching, research and community service activities of the University and the basic administrative element for academic activities.

The first four Schools were -

Australian Environmental Studies;
Humanities;
Modern Asian Studies; and
Science.

The University intends that as it grows, new Schools will be created and that existing Schools may divide to produce new academic combinations.

A fifth School, Social and Industrial Administration, was commenced in 1979, offering degrees in Administration and Informatics.

The Organisational Structure of the University is relatively flat. In addition to the School or Academic Divisions, the General Divisions of Library, Secretariat, Business Management and Site and Buildings were created, each equivalent in rank and reporting through an Executive Officer to the Chief Executive Officer, the Vice-Chancellor in Australian terms, and to the University's governing body, the Council.

The University has always adopted the notion that the welfare of the students was one of the principal responsibilities of the staff. It believes that students and staff should belong to stable academic groups within a University capable of providing adequate formal and informal educational situations.

The Council, therefore, accepted that the planned size of the University be about 10 000 students, in Schools which might ultimately not be greater in size than 1500 staff and students.

Academic Philosophies and Physical Planning

The "Schools" concept had a dominant impact on the Site Planner. Placed together, the Schools might re-form into the traditional disciplines and departmental groupings. If separated by too great a distance, the isolation might militate against the idea of a university as one community.

The Library, as usual the heart of the academic complex, provided no physical planning problems.

The desire for places where staff and students could intermingle pointed to the replacement of separate Students Union Building and Staff House by a single University House, providing a variety of spaces in one building, itself being a focus for the community. Other smaller spaces would be provided either within the Schools' buildings or close by.

The usual site planning principles were used: a high degree of pedestrian/vehicular segregation; the establishment of pedestrian precincts; visual barriers between carparks and peopled places and buildings; walk-up buildings; buildings oriented for climate; short walking distances; compact academic core; multi-use zones and maximum utilisation of buildings and spaces.

THE SITE

The site is one of the largest tracts of natural forest still remaining within the boundaries of the City of Brisbane and is an extension of Toohey Forest, which is itself reserved as natural parkland.

The main characteristic of the site is its undulating landscape, divided by erosion gullies, such as Mimosa Creek and Rocky Water Holes Creek, flowing eventually into the Brisbane River. Typically, the site is dry sclerophyll forest with a rich understorey of xanthorrhoea, or grass tree, and banksia collina. Along the creek beds are found paper barks and ferns.

The site is a naturalist's delight: there are 139 recorded plant species, two of which, the Eucalyptus Baileyana and Eucalyptus Planchoniana, are found virtually nowhere else on mainland Australia; the grass trees, the most distinctive plant on the site and related to palm trees, grow only about one-third inch per year, so that any plant thirty inches tall is at least 100 years old, and there are many over 6 ft high. The site supports about 80 species of bird with such wonderful names as the Spangled Drongo, the Black Headed Pardalote and naturally, the Kookaburra. Twenty species of lizard, including the Goanna, are commonly seen on the site but the 11 species of snake, including some venomous, known to live there are shy and rarely seen. Brush tailed possums, squirrel gliders and more than forty species of butterfly are also found in our fascinating and precious wonderland which, in spring, is a blaze of colour.

The very factors which distinguish the campus, made it unattractive to early developers and led to its preservation in its natural state.

PLANNING AND CONSTRUCTION

The Compact Development Plan

The early planners were certainly aware of the site's natural beauty and the temptation may have been to "lose" the buildings in the landscape, much as say the University of California at Santa Cruz or the University of Newcastle in Australia have done.

But when the building development for a university of 10 000 students was laid out on a plan, it was apparent that there was really very little chance of losing the buildings amongst the trees. Moreover, the advantages of compact development seemed overwhelming: short walking distances, economy of roads and services and the creation of urban spaces in contrast to the natural bushland were all factors to be considered. In particular, it meant that a large portion of the site could be left in its natural state thus minimising future landscaping and redevelopment costs.

And so it was decided to proceed with a compact development of the University, to provide a peopled place within the natural environment of the forest.

The University's academic development plan lent itself to a linear plan which, in site planning terms, leads one to the notion of a pedestrian street, offering directional focus and orientation. The street becomes like the town street, the centre of activity, offering changes in visual experience. In practical terms, the pedestrian street becomes the easement for all utilities and services, the spinal cord of the site: this notion in fact has led to the path's official title of "The Spine Path".

The only areas for easy building were grouped together, in the basin within the pre-existing Ring Road. This area became the academic core, serviced from the Ring Road by minor service roads. Carparks were to be placed outside the Ring Road, thus segregating pedestrians and major traffic flows.

The remaining element to be considered was that of housing. It has been evident in Australia since the seventies, that students prefer living in flats, or apartments, rather than the traditional halls of residence. The southward-facing slopes of the site were ideally suited to this type of housing development, that is clusters of flats, with some halls of residence.

The Site and the Plan were ideally matched because of the topography:

- The Spine Path running northward from the University entrance would pass through the residential area, The Village, with views to the border ranges of New South Wales.
- Beyond the Ring Road, through an underpass the academic buildings, each distinct in form and character, would be unified by the pedestrian street. The buildings would be oriented east-west for better climate control.
- At the centre of the Academic Core was the Library.
- Further north, University House would provide the commercial centre, student union, dining facilities and licensed club. A similar facility, but also providing indoor sports facilities would be located at the opposite end of the academic core, in The Village.
- The Spine Path continued northward to join with Ring Road and the University's other entrance from the South East Freeway to the City.

The Development Plan took form. Based on walk-up buildings, it indicated not so much where buildings should be placed but rather where they should not be placed. It indicated space for currently uncommitted expansion, pedestrian and vehicular routes, sports areas and a basic landscape plan. It was intended that the Development Plan, supplemented by Architectural Controls should be the guide to development over the years.

Selection of Consultants

The initial buildings were designed and constructed in the manner common in Australia in 1973: by the "traditional" design and tender method. Architects and engineers were selected for each of the first four major buildings on the site and the University took the unusual step of using this group as a panel together with the Site Planner to comment on the individual designs produced, a step which we believe led to overall cohesion and a better end-product. Other architects have been employed for some of the later buildings and since 1978, the University has used both the "traditional" system and Project Management techniques as a development process.

CONSTRUCTION

Construction began in 1973 and when teaching began in March 1975 the Library, University House, Humanities and Science buildings had been completed. In 1985, we have fourteen major buildings totalling 660 000 ft^2 gross floor area, including 163 000 ft^2 in residential accommodation for 700 students and staff. The present replacement value of buildings is $A63 000 000. Planning is currently in process for a new general purpose academic building of 57 000 ft^2 (gfa).

ARCHITECTURAL CONTROLS

While not dictating the exact shape and form of each building, the Architectural Controls imposed ensure some unity while allowing flexible growth. If the building form is allowed to follow functional need it's likely to be a better piece of architecture anyway.

The controls can be summarised very quickly into two categories:

Visual:
- External walls are to be white or off-white concrete or concrete masonry.
- Roofs are white metal deck.
- Window frames are bronze aluminium with clear, non-tinted glass.

Functional:
- Buildings are oriented east-west for climate control.
- Sun control is to be inbuilt using minimum fenestration on east and west facades and external sun screens or shades on exposed windows.

SITE SERVICES

The Spine

The compact plan has simplified our construction and helped minimise our service costs. The Spine Path contains the central nervous system of services: high voltage power (11000V), telephones, water and fire services, chilled water for air-conditioning, computer and special services cable. As buildings are constructed abutting the Spine like ribs, the services are "plugged in". Allowance is made in these connections for future outward expansion of these buildings.

Chilled Water

Being relatively new on the scene meant that Griffith was able to plan its services infrastructure and, hopefully, avoid the mistakes of others. It was the first university in Australia to service the air-conditioning needs of all buildings from a Central Chilled Water Plant. While central chilled water is relatively common in North America, it was significant for us to plan for this from the outset, laying a 300 mm diameter reverse-return ring main in the Central Academic Core. The savings produced by using Central Chilled Water as you are aware are significant in terms of diversity, operation, energy and maintenance. The University has thus far been able to maintain its policy of providing air-conditioning only from this service, eliminating the problems of numerous, isolated installations of chilling plant or self-contained room air-conditioners.

Central Control and Monitoring

The University was also the first in Australia to install a Central Control and Monitoring System. Because of our size, we opted in 1975 for a Honeywell Alpha/Delta 1000. We bought a basic system comprising the operator's terminal, front end and four data gathering panels. We have used our own developed expertise to extend the system to 25 DGP's with three printers, VDU's etc. There are now better systems around, including some developed in Australia but ours has served us relatively well. The time is not too far off however, when we will need to upgrade the system to provide history, graphing and analysis facilities.

LANDSCAPE DEVELOPMENT

At the outset, we were anxious that our operating costs should be minimised. This concern included landscape maintenance as well as building maintenance and so our landscape development plan concentrated on reinstating, wherever possible, the natural environment; that's not to say of course that there wasn't a need for lawn areas or paved areas but it meant that formal gardens of roses or petunias would not be part of the landscape.

Instead our landscaping has been done with a front end loader, cranes and other heavy machinery.

Whenever an area for a new carpark or building is cleared, the existing natural landscape is "relocated" to another area awaiting reinstatement. Quite often, the relocated landscape strikes so well that it outstrips the natural environment in regeneration. Even difficult specimens like the xanthorrhoea or grass tree, which we were told could not be transplanted, have achieved an eighty percent strike rate because of the bulk earth moving procedures adopted.

FACILITIES MANAGEMENT

The University adopted the notion in its early years that facilities management should integrate all aspects of physical planning and operation for best effect. In this way feedback from operation could better influence the planning of new buildings to reduce maintenance and operating costs.

Site and Buildings Division was established with this aim. Its principal function is to provide the necessary facilities and environment so that the University can accomplish its primary responsibilities of teaching and research. Its range of duties include -

- general development of the University site
- planning and the construction of buildings, minor works, site works and landscaping
- establishment of architectural and engineering standards
- provision of utilities
- traffic and parking control
- maintenance and operation of physical facilities
- custodial services
- grounds maintenance
- security (campus police)
- room allocation and scheduling.

Total facilities management is thus the responsibility of one unit. All building work is strictly controlled so that facilities are not allowed to degenerate into slums by random alteration or addition. Maintenance is carried out to acceptable University-wide standards. These standards apply to all buildings on the campus including residentials, food outlets and student facilities which are University buildings leased to the users. See the Organisation Chart Figure 3.

It's always dangerous to draw comparisons of costs across a University system as dispersed as that in Australia where no two universities have the same mix of courses and where climatic conditions range from tropical to winter snow. It's even more dangerous to draw comparisons across the Pacific. However, to give you some idea of costs, I have included some data in Figure 2. All costs are shown in Australian Dollars. When this paper was prepared in May 1985, the Aussie dollar was floating at about US66 ¢ .

EFFECTIVENESS

When the plan for the University was set down in 1973, it was described as one which did not "impose" itself on the landscape and one which would encompass change.

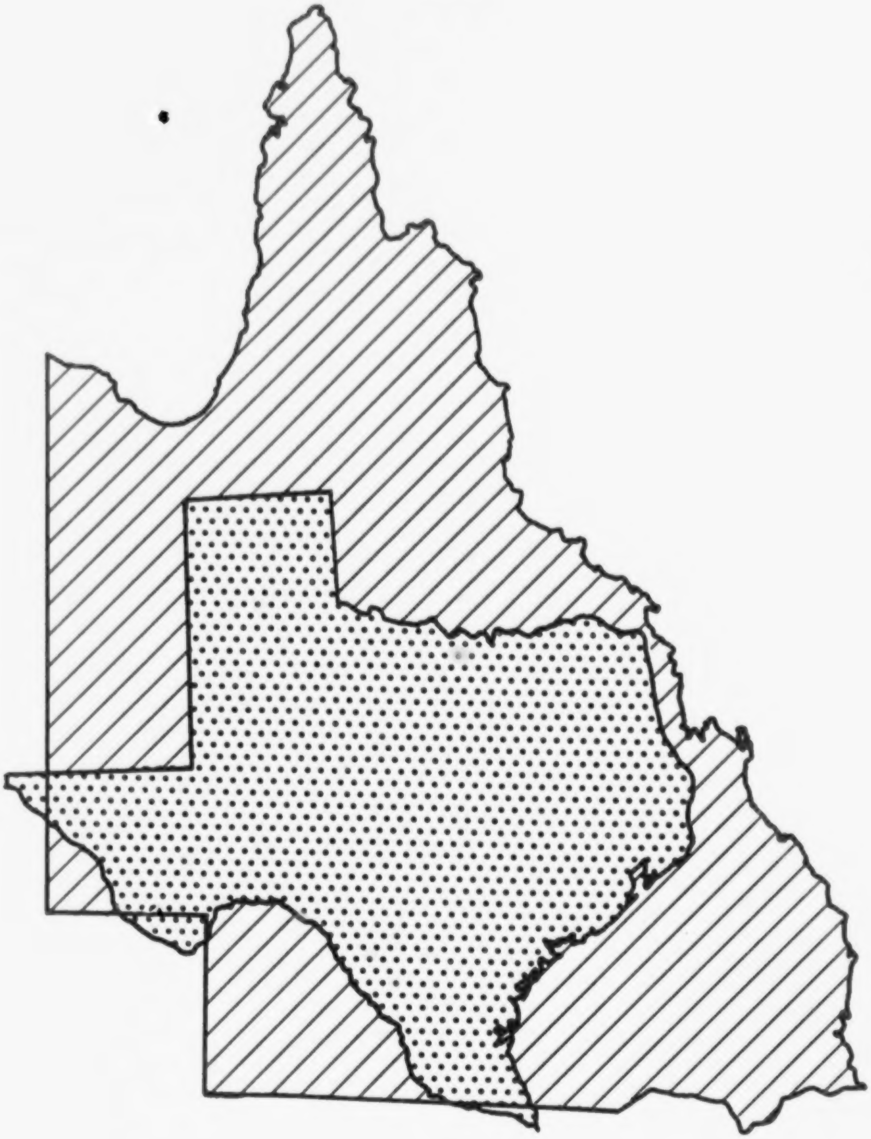
In the years that have followed that plan has been tested and found to have been effective. In 1979, a Review of the Development Plan was carried out because of Government's intended restrictions on growth in universities. Only minor amendments were necessary to reduce the scale to that of a university of 4000 EFTS compared to the originally intended 10 000. Since then, the Government has again revised its ideas for Griffith so that now it is intended to grow to about 8000 EFTS by the year 2000. The Development Plan allows this continual review, contraction and growth to occur by providing a guide for the University's physical development without imposing limits.

The University is too conscious of change and its own role as an agent of change to pretend it has developed a timeless Master Plan.

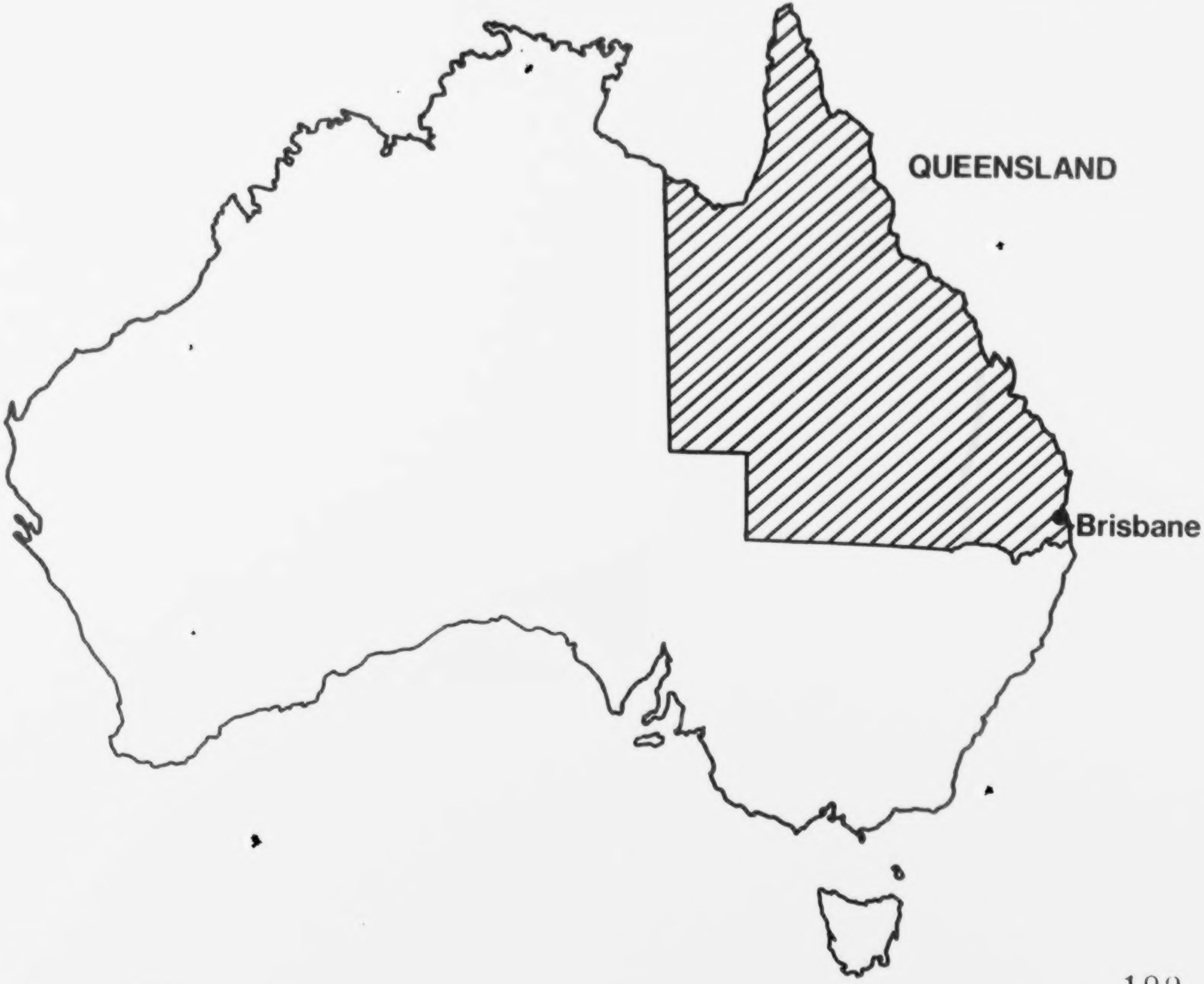
Development is guided by long-term principles to give coherence but is still specific to the University as it exists and as it will be in the future.

Every decision on buildings, roads, carparks or services limits and conditions all subsequent decisions, but we believe that provided the University resists compromise of its planning principles, the succession of development plans should give full scope for the development of a vibrant institution on a site of rare quality.

To visit or work in Griffith is to experience an organic integration of situation, landscape, people, activities and the built environment.



QUEENSLAND:
TWICE AS BIG AS TEXAS


QUEENSLAND
Brisbane

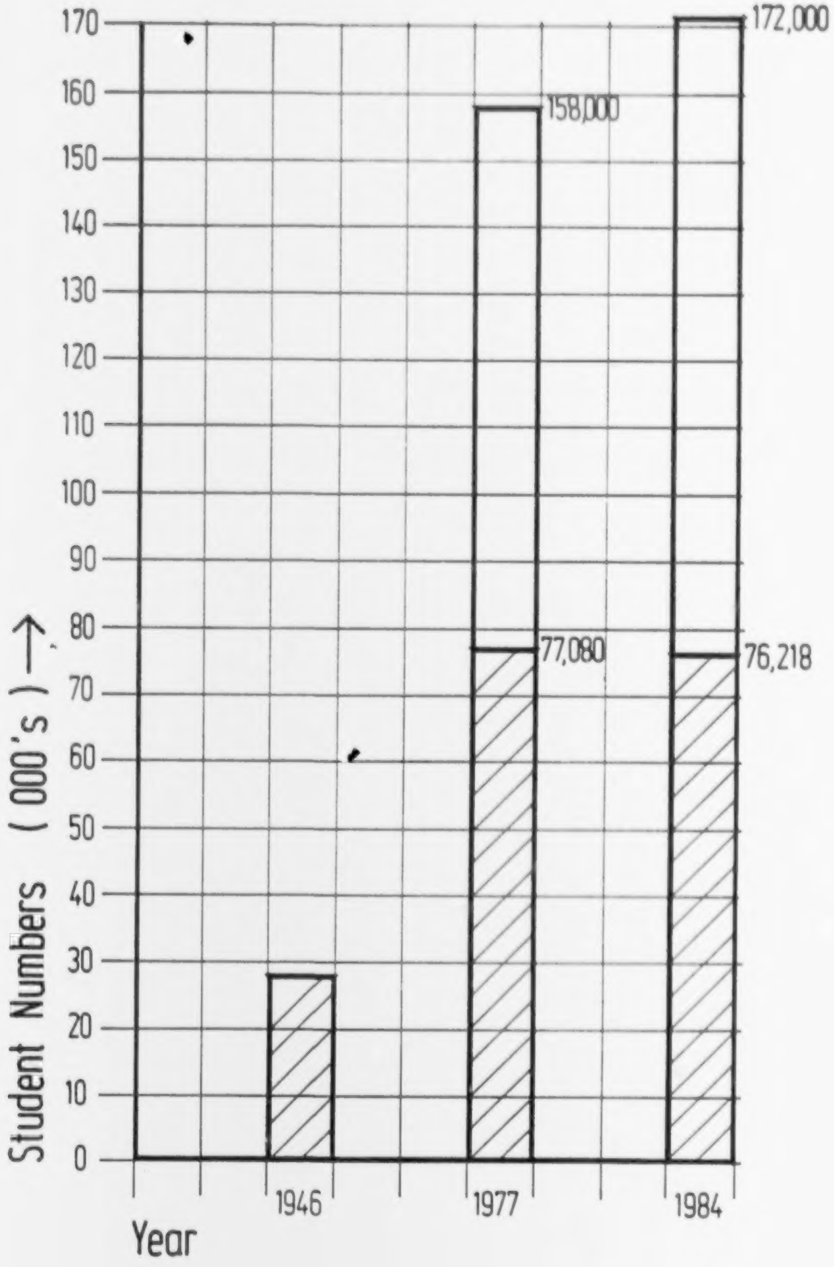


FIGURE 1 - GROWTH IN STUDENT NUMBERS
(AUSTRALIAN UNIVERSITIES)

▨ Six Pre-war Universities

☐ Thirteen Other Universities

APPA Classification	Student Load	Maintenance $\$/\mathrm{ft}^2$(gfa)	Custodial $\$/\mathrm{ft}^2$(gfa)	Energy $\$/\mathrm{m}^2$	Grounds \$/acre Maintained
Range	2285 - 16 187	0.46 - 1.18	0.30 - 2.15	0.49 - 1.23	604 - 9117
Griffith	2363	0.75	0.30	0.78	604

Figure 2 - Range of Costs in Australia (1983 Data)

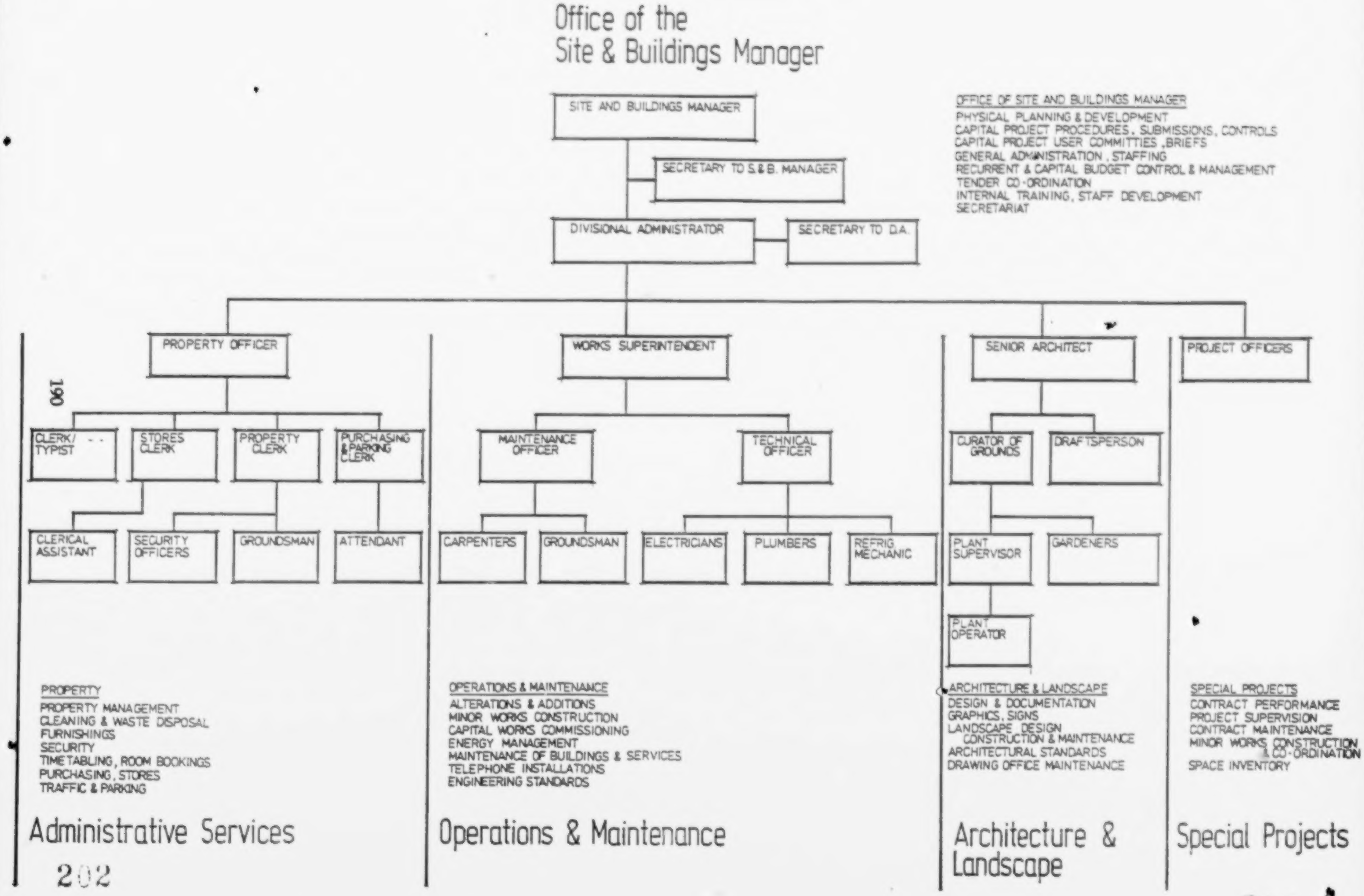

Office of the
Site & Buildings Manager
SITE AND BUILDINGS MANAGER
SECRETARY TO S.& B. MANAGER
DIVISIONAL ADMINISTRATOR
SECRETARY TO D.A.
OFFICE OF SITE AND BUILDINGS MANAGER
PHYSICAL PLANNING & DEVELOPMENT
CAPITAL PROJECT PROCEDURES, SUBMISSIONS, CONTROLS
CAPITAL PROJECT USER COMMITTIES, BRIEFS
GENERAL ADMINISTRATION, STAFFING
RECURRENT & CAPITAL BUDGET CONTROL & MANAGEMENT
TENDER CO-ORDINATION
INTERNAL TRAINING, STAFF DEVELOPMENT
SECRETARIAT
PROPERTY OFFICER
CLERK/TYPIST
STORES CLERK
PROPERTY CLERK
PURCHASING & PARKING CLERK
CLERICAL ASSISTANT
SECURITY OFFICERS
GROUNDSMAN
ATTENDANT
WORKS SUPERINTENDENT
MAINTENANCE OFFICER
TECHNICAL OFFICER
CARPENTERS
GROUNDSMAN
ELECTRICIANS
PLUMBERS
REFRIG MECHANIC
SENIOR ARCHITECT
CURATOR OF GROUNDS
DRAFTSPERSON
PLANT SUPERVISOR
GARDENERS
PLANT OPERATOR
PROJECT OFFICERS
PROPERTY
PROPERTY MANAGEMENT
CLEANING & WASTE DISPOSAL
FURNISHINGS
SECURITY
TIMETABLING, ROOM BOOKINGS
PURCHASING, STORES
TRAFFIC & PARKING
Administrative Services
OPERATIONS & MAINTENANCE
ALTERATIONS & ADDITIONS
MINOR WORKS CONSTRUCTION
CAPITAL WORKS COMMISSIONING
ENERGY MANAGEMENT
MAINTENANCE OF BUILDINGS & SERVICES
TELEPHONE INSTALLATIONS
ENGINEERING STANDARDS
Operations & Maintenance
ARCHITECTURE & LANDSCAPE
DESIGN & DOCUMENTATION
GRAPHICS, SIGNS
LANDSCAPE DESIGN CONSTRUCTION & MAINTENANCE
ARCHITECTURAL STANDARDS
DRAWING OFFICE MAINTENANCE
Architecture & Landscape
SPECIAL PROJECTS
CONTRACT PERFORMANCE
PROJECT SUPERVISION
CONTRACT MAINTENANCE
MINOR WORKS CONSTRUCTION & CO-ORDINATION
SPACE INVENTORY
Special Projects

Figure 3 - Site and Buildings Organisation

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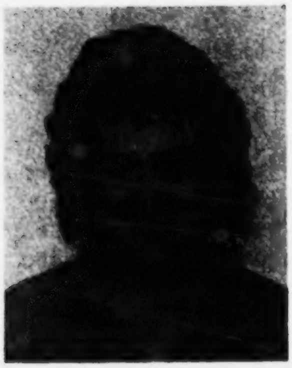
PROFESSIONALS WORKING TOGETHER
APPA
SAN DIEGO, CALIFORNIA • JULY 10-13, 1985

Friday, July 12, 1985



The Computer as a Control Factor in Productivity

Pamela E. Lash
Operations and Systems Supervisor
Bryn Mawr College

One of the major problems facing colleges and universities today is the reduced buying power of the dollar. Many institutions have been forced to cut spending in order to hold down tuition. Consequently, many Physical Plant departments have been thrown into competition with the other institutional departments and programs for a limited amount of funding. Unfortunately, this budget crunch has come at a time when deferred maintenance problems are becoming an unavoidable reality. In light of this, it has become increasingly important to expand spending capability through more efficient use of current resources rather than through large budgetary adjustments. The analysis required to effectively identify problem productivity areas entails many tedious calculations best left to the computer.

Prior to the installation of our computer system, we had two major problems holding down our productivity levels and no simple way to identify solutions. First, our manual work control system could neither ensure that a job would not get lost in a shop's backlog nor ensure that a job was correctly reported as complete. Secondly, we had no way to track material use or to account for the money put into material supply. We had no effective reporting system which would give total cost of materials used in job orders to compare with the total amount of money paid to suppliers. After careful consideration, we decided that the problem was not with our basic work control routine but with the type of resource that we had chosen to run it. We would have needed an enormous amount of time to devote to the withdrawal of information from a single hand-written log in order to gain the type of control that would be necessary for a marked increase in productivity.

The work order unit forms the base of our productivity control structure. Information about each work order is entered into the computer in four different groupings. First, information from the work order form itself is entered giving the date, location, and other details of the work to be done. This data originates from trouble calls, written work requests, in-house projects, and preventive maintenance routines. Second, a member of management records estimated manhours and material cost for each work order. Third, the cost of any stock withdrawn from the inventory room is entered against the work order. Finally, completed work order data is entered including the date, manhours used, and any material cost as reported by the shop foreman. Careful analysis of this data can yield results useful to the improvement of productivity.

Backlog Items

The computer produces listings of all outstanding work orders by shop. Jobs requiring advance material ordering of more than one or two days are specially tagged until the material is received. The remaining work orders are available for scheduling in several different categories. Informed decisions to contract small work can then be made on the basis of how much the current work load would suffer given any significant additional demands.

Scheduling

We distribute a week's work load at a time with unscheduled space allotted for emergency work during the week. The shop foremen meet with us at the end of the week to discuss their complete and incomplete work. Incomplete work is examined and questioned at this time to see if the problem lies in a work overload, material unavailability, or a manpower shortage. We have found that just making the foremen accountable for a definite amount of work within a defined time period has increased our work output by making it desirable to move through the work load as quickly and efficiently as possible. Now, more often than not, the reason for an incomplete work load results from factors not within our control. We allow for a certain amount of unscheduled emergencies per shop (the percentage varies with the shop) and assign these jobs as they arise. The preventive maintenance work is automatically generated and assigned by the computer at the beginning of each week. The remaining assigned work as determined by the available manhours per week for the shop and the estimated manhours for the incomplete work orders is then divided between routine maintenance and permanent improvement/deferred maintenance projects. We have recently obtained the support of the administration to delay some routine maintenance work in order to complete more energy conservation and permanent improvement projects with in-house labor. The balance between these types of projects is delicate and would be difficult to maintain without the data given to us by the computer.

Progress/Productivity Reporting

We use the computer to examine the total reported manhours for a time period (usually a month) in relation to the total available manhours for the same time period. We figure the ideal percentage of work time for a shop allowing for the foreman to spend a portion of his time supervising rather than working the tools. Then, assuming that the reported manhours are somewhat inflated to allow for travel time, inferior material or tools, etc., the difference between these two figures forms a basis to work from to improve the output of a shop through closer supervision and better organization. Next we compare the estimated manhours with the reported manhours work order by work order. The computer will flag any work orders where the comparison falls outside a predeterminable ten to twenty percent range. A quick scan of this list often shows many projects where our estimated time was inaccurate. Many of our jobs feed upon themselves. Wiring and plumbing existing in many of our buildings cannot be repaired without replacing an entire line. The projects where our estimated time was not seen to be in error provide a basis for discussion with the foremen. Again, accountability reduces the occurance of overly inflated reported manhours. This time must be accounted for somewhere, hopefully on additional work orders, increasing the shop's output. We send confirming copies of the work orders back to the requesters after the work has been reported to be complete which cuts down on the number of places slack time can be buried. Not only does this ensure that few incomplete jobs are reported as complete, but it also serves to improve our relations with the college community by giving them a structured format for feedback on our work.

Material Ordering

A large majority of materials are stored in the stock room until their withdrawal. We have a preapproved stock level on most small, commonly used items. Other items are ordered as needed. The material required to complete most of our work requested is either stored in the stock room or is available locally within one or two days. The work orders that require stock not readily available are tagged so that they are not issued until the material is in hand. The shop foremen are asked to submit purchase requisitions for material not in stock within a day of receiving their weekly work load. These requisitions are submitted and approved by work order number only. This method helps us to ensure that extraneous material is not ordered and also helps ensure that all specially funded projects are charged accordingly.

Material Withdrawal

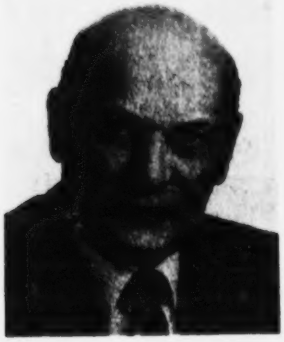
We are notified when the material for a work order arrives in the stock room. The workers need to present their copy of the work order to retrieve any material from inventory. A material list is recorded at the desk against each work order number and the work order is signed and dated indicating a material withdrawal. We receive a weekly report from the stock room which not only lists but also totals the cost of all material drawn that week against each work order. This cost is entered against the work order in the computer for comparison to the estimated cost.

Cost Analysis

The computer compares the estimated cost to the total cost as reported by the stock room work order by work order checking for jobs outside of a ten percent range. These work orders are flagged and listed for examination along with any work orders returned by the requester as incomplete. Again, most often our estimate was inaccurate. However, excessive material draw shows immediately making it easy to pinpoint problem areas. Just the fact that the men know these checks exist and that they will be questioned about excessive material draw has reduced our material shrinkage over the past year.

Concluding Remarks

The computerized work and inventory control has given us the capability to closely analyze our work and material flow. Using the resulting information we have been able to identify problem areas and concentrate our efforts on correcting them. Foremen can no longer lose work orders in the shuffle or leave them unnoticed on the bottom of the pile. The backlog listing won't drop any work order until it has been completed or cancelled. Work orders returned before completion are sent back to us by the requester. We are now able to account for materials purchased by monitoring the dollar flow from the stock room to the job site. Disappearances along the way are increasingly difficult to disguise. We are able to pinpoint problem sources down to the work order, not just to the shop. Shrinkage may never be completely eliminated, but our goal is to make its occurance as difficult as possible. With the help of our custom software, we seem to have a good grasp on the problem and its solution.



CHILLED WATER STORAGE

Miklos G. Kurz, P.E.
President - Transflux International Inc.
Energy Consultant Engineers

Energy storage is a rather old concept. Its acceptance as a viable economical alternative to the solution of many a problem varies with the times. Lately the economic climate favors such installations. This paper intends to deal with one particular form of those devices, the atmospheric chilled water storage facility.

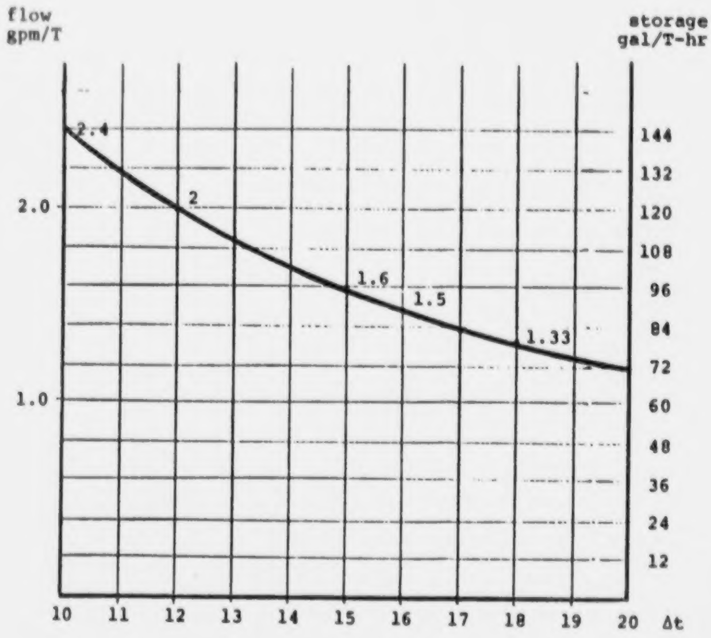
Chilled water storage can satisfy one of several technico-economic endeavours, as it

- reduces the size of new plant
- provides for new load without adding to the plant machinery
- extends the reach of an existing distribution system
- increases the delivery capability of an existing distribution system
- makes better use of limited power supply systems
- makes use of night tariffs
- improves plant efficiency
- improves cogenerated energy use rates

I believe it's an impressive enough list to attract attention to how imperative it is to consider storage whenever a chilled water plant and/or distribution system needs to be designed, expanded or just investigated. Before we go down that list step-by-step, let me describe atmospheric storage in general and one installation in particular. That one was designed by us and is presently under construction at The Hartford Steam Company in Connecticut.

CHILLED WATER STORAGE

Chilled water (chw.) as used in most air conditioning systems conveys cooling energy by dissipating 10–15 BTU per pound of circulated water. So when stored, every pound of water typically stores 10–15 BTU. Figure 1 shows the relationship between temperature differential, circulating flow rate and storage volume required to store a T–hr. The effect of increasing temperature differential is striking. So as a rule the higher that differential, the more economically viable storage becomes. It is important to recognise that the actual operating temperature differential is what governs, and not the design one. Before any storage is included in a system, measures have to be taken to control the use of chw. throughout the system. This is achievable, but seldom done, by controlling the return water temperature at each user building. To this end, for example, revision to new user hook-up instructions and control installations at existing major users have been initiated last year in Hartford in anticipation of the storage installation.



CHW. TEMPERATURE DIFFERENTIAL V.
SPECIFIC FLOW RATE AND
SPECIFIC STORAGE VOLUME

FIGURE 1

Usually only the fairly conventional concepts of storing chilled water need be considered. Of that there are only a few practical, basic variants:

by Pressure:

- atmospheric
- pressurized

by Method:

- primary
- secondary

by Location:

- central
- dispersed

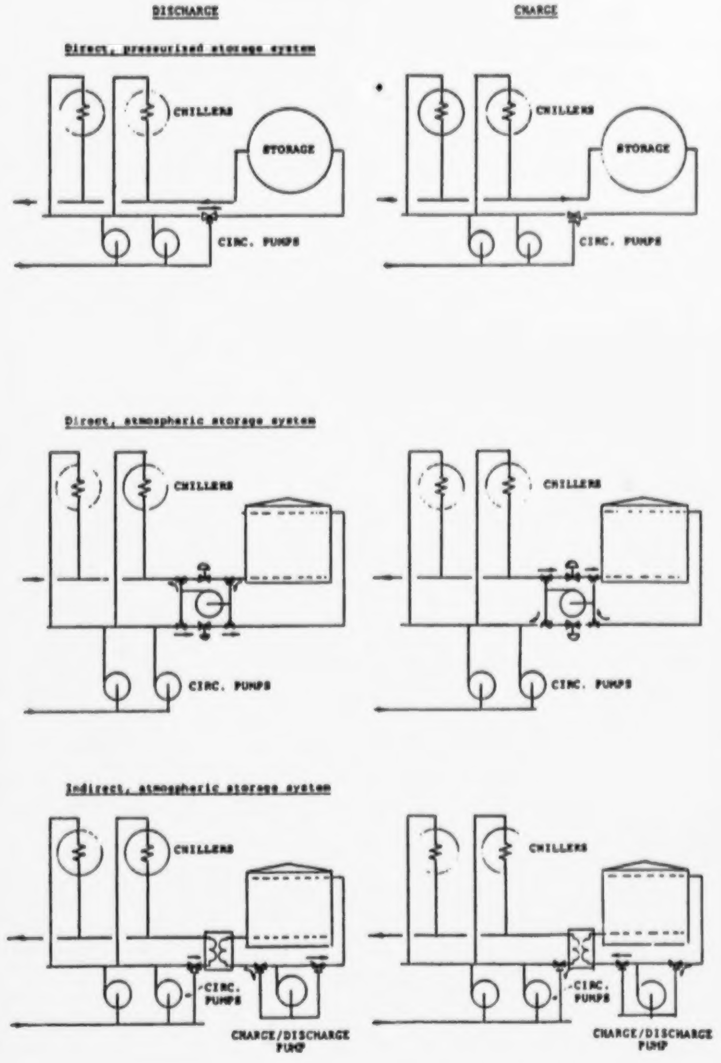

DISCHARGE
CHARGE
Direct, pressurized storage system
CHILLERS
STORAGE
CIRC. PUMPS
Direct, atmospheric storage system
CHILLERS
CIRC. PUMPS
Indirect, atmospheric storage system
CHILLERS
CIRC. PUMPS
CHARGE/DISCHARGE PUMP

FIGURE 2

The three most practical combinations of the above are represented on Figure 2 as

- direct (primary) pressurized chw. storage
- indirect (secondary) atmospheric storage
- direct (primary) atmospheric storage

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PRESSURIZED STORAGE

Pressurized storage is the simplest in concept. Nothing but a tank and switchover valving need to be added to the system. The system stays truly closed and the tank operates as a parallel additional refrigeration machine in the discharge mode and as a parallel additional user in the charge mode. The problem is economics. When large volumes of chw. need to be stored, large diameter tanks are needed and the cost is prohibitive, particularly where the pressure is also high. The pressure is usually dependent on the elevational difference between the low and high points of the distribution and user systems. Primary chw. is piped directly usually to all user coils so the highest coil is the one which defines the cover pressure needed. Moderate pressure and moderate volume requirements may make the pressurized storage viable, mainly because of its simplicity. In designing one, the propane tankage analogy could be used. That is a battery of long and slender vessels to keep the weight down. Such an installation may become economical in dispersed storage with limited output, as one covering short pronounced peaks.

ATMOSPHERIC STORAGE

Atmospheric storage is an open vented tank, above or below ground. Aboveground tanks are routinely built to very large sizes (~20 million gallons) and their specific cost is low. Real estate availability, cost and esthetics may be the problems to overcome. The larger the tank, the less problem is heat infiltration since the volume to surface aspect ratio is very large. While some insulation of the surfaces is needed, it is mainly to prevent condensation and associated problems. Underground no insulation is required. The details of an aboveground storage installation will be discussed later.

The underground atmospheric storage installations are typically concrete structures with a number of large square cells and solid slab tops. No insulation is required since soil and return water temperatures are nearly identical and the supply is only a few degrees lower. The typical approximately 12" concrete wall is insulation enough.

Most have the water introduced and withdrawn through a perforated pipe distribution network. The idea is to move the water in and out at laminar flow velocities and thereby prevent mixing, without any barrier between warm and cold phase. Such a pipe network, usually made of asbestos cement, is expensive and wastes considerable portions of the storage volume. The volume to flow rate ratios are also so high that one can question the usefulness of such an installation. The front with or without distribution moves 1 to 2 inches per minute. The real problem is conductance. As the warmer water sits on top of the cold water during the charge and discharge cycles heatexchange takes place. In about six hours an approximately 4 ft. layer takes up some intermediate temperature between storage and return. Most of that can be considered as lost since a constant supply temperature is required in most systems. Four feet is a very high percentage of volume at installations varying from 15 ft. to 40 ft. in total height.

The answer to these problems seems to be a membrane to separate the two phases. It definitely prevents any possible mixing no matter where and at what velocities water is introduced or withdrawn. One problem insufficiently addressed at some installations was that the membrane covered the suction nozzles and stopped the flow. This can be easily prevented by proper design. Folding the sides of circular membranes is no problem. In square tanks the folding of the corners requires careful construction and may need to be tested for any given geometry.

Our proprietary design of the membrane used at the Hartford installation added another important element. The membrane is insulated to prevent conductive heat transfer entirely and make the total volume useful. The insulation gives considerable buoyancy to the membrane, which would act as a piston if not redressed. A weight is therefore applied to the top of the membrane and thus it restores it to a close to neutral weight in medium temperature (48°F) water. Figures 3 and 4 show the model of this installation with the membrane in the bottom and top positions.

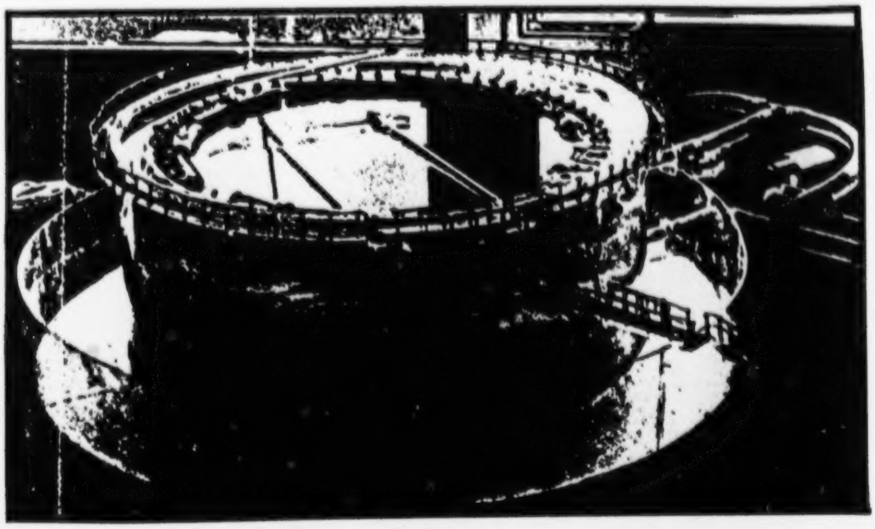

FIGURE 3

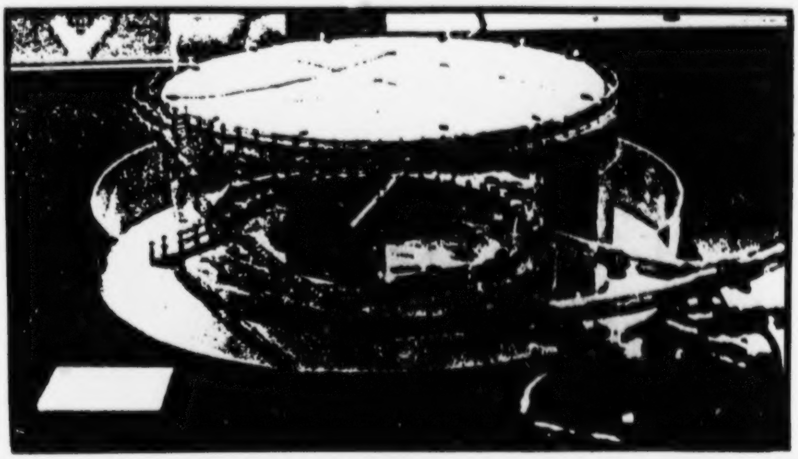

FIGURE 4

PRIMARY OR SECONDARY STORAGE

Storage called primary is when the circulating liquid itself is stored. Secondary storage is where the liquid stored is part of a separate hydraulic system.

Obviously primary storage is simpler and in most cases cheaper as long as the problem of how to handle the pressure differential between the system and the storage is solved at a reasonable cost.

The simple approach is to discharge into the vented storage tank through a pressure reducing valve and return the water by operating a set of pumps. The cost of this pumping can prove prohibitive where the cover and supply pressures and power cost are high. It was found that adding head recovery turbines to the pumps drawing water from the tank is quite cost effective. This arrangement--shown on Figure 5--saves all the work except that lost by the combined efficiencies of turbine and pump. Since these can be at around 80% the combined loss is reduced to about one-third.

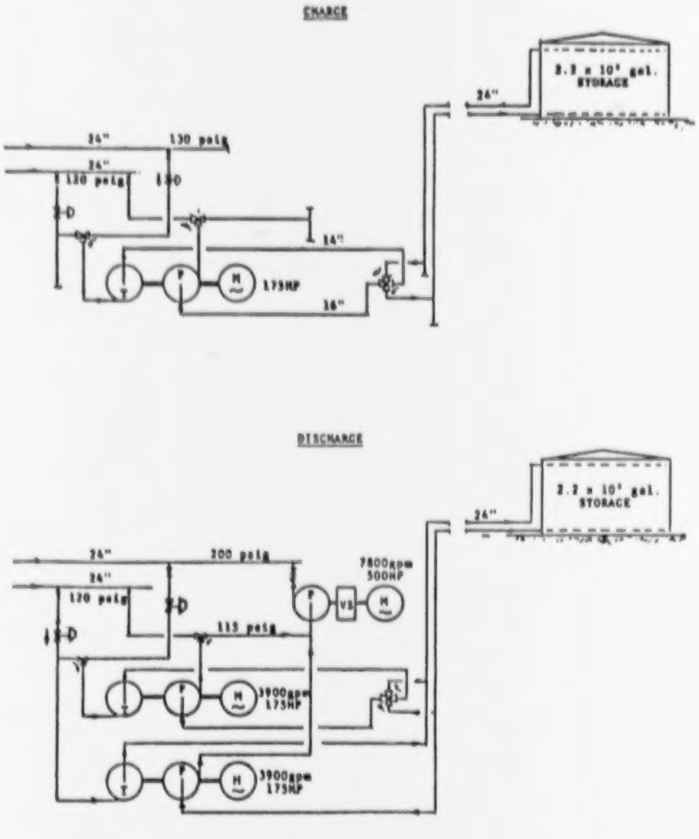
CHARGE
2.2 x 10⁶ gal.
STORAGE
24"
24"
130 psig
24"
120 psig
130
14"
P
M
175HP
16"
DISCHARGE
2.2 x 10⁶ gal.
STORAGE
24"
24"
200 psig
24"
120 psig
7800gpm
500HP
P
VS
M
115 psig
P
M
3900gpm
175HP
T
P
M
3900gpm
175HP

FIGURE 5

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The secondary storage option, as it was shown on Figure 2, involves a heatexchanger between the system and the storage. The integrity of the system is completely preserved and a very low pressure open circulating system performs the storage function. The direct power consumption of this method is very low. The indirect power consumption is substantial. This is due to the two heatexchange processes involved. One approach temperature of say minimum 1-1/2°F is involved in charging the tank and another similar one in discharging it. For a 41°F send-out therefore at least 38°F chilled water has to be generated. While there is no refrigeration loss involved in comparing the two processes, there is incremental work needed to produce the colder temperature. This increment, typically .1-.2 HP per T refrigeration is the substantial added operating cost. While platen heatexchangers are capable of producing the required close approaches and their specific cost is low, the investment needed can be quite substantial.

A variant of secondary storage is ice storage and it may be considered in some instances. It reduces the storage volume requirements 10-15 fold. It cannot be considered however in conjunction with an existing system, unless machines producing at least 26°F brine are also added and the higher energy cost of producing a T-hr. is evened out by some other advantage as night rates. This subject however is outside the limited scope of this paper.

CENTRAL AND DISPERSED STORAGE

Whatever the selected form of storage, its location in a central refrigeration system can be crucial.

Central storage, that is storage in the vicinity of the refrigeration plant, can be equated with the addition of a machine to the plant at a lesser cost. While the installation of a machine runs $450 to $600 per T, storage can be built in the $250 to $350 per T cost range. The machine cost range is dependent on whether building space is available, the type of drive, the availability of the additional power or steam and the method of cooling. The storage cost on the other hand varies with above- or underground construction, size and whether it is combined with the construction of another structure. The savings are substantial, but it can be said that a new machine and storage are not equivalents for true comparison. It is true that storage has a nominal capability severely limited in duration, while a machine can produce same without any time limitation. This is mitigated by the fact that if it is used in an air conditioning system the load has the same kind of well defined time constraint. On the other hand the nominal capacity of storage is a defined value only in terms of pumping capacity available. If an installation is designed to produce say 5000 T for five hours in normal operation, replacing a 5000T machine, that rate is not a true limit of its instantaneous capacity, as it is for a machine. Having enough pumps, the same storage can be discharged in an emergency at a 10000 T rate but for half the time. How the disadvantage and the advantage are valued is a matter of individual considerations.

Dispersed storage, that is a storage facility at a point along the distribution system, far removed from the refrigeration plant, is an entirely different matter. Here the comparison overwhelmingly favors storage versus a new machine. Usually it is undesirable to build a new plant. Major system expansion in many a case is limited not only by insufficient plant capacity but also by inadequate distribution capacity. Dispersed storage can provide the solution to both.

THE STORAGE FACILITY AT HARTFORD

An aboveground oil tank is being converted. It is 100 ft. in diameter and 40 ft. high, and is capable of holding 2.3 million gallons of 40°F water, which at 16°F temperature differential, holds 25600 T-hr. A membrane type construction was selected.

The proprietary solution to the several problems such a task presented can be summed up simply. The roof of the tank was removed and a windgirder was erected to give rigidity and to serve as a walkway around the top of the tank. The roof plate is reused as the top of the membrane resting on 2" of reinforced plastic sheet enclosed styrofoam insulation. This layered disc has a specific gravity approximately matching that of the fluid. The roof steel truly serves no other purpose but to counter the buoyancy of the insulation. At the near laminar flow conditions and at the small temperature differential, no detectable heat transfer is expected to take place in six hours. The side of the membrane is also made of reinforced plastic and it forms a slightly conical cylinder. At the base it is pressed against the tank wall by a spanner ring made of pipe. At the top it is clipped to the steel of the disc, forming a tight cavity of variable volume.

The tank, as it is part of a closed system, is always full. Whatever the flow is into the tank the same amount is removed, controlled by two flowmeters and biased by tank level. Because the tank is always full the roof was replaced by a floating roof. It is made of fiber reinforced plastic. Its two layers sandwich 2" of polyurethane foam insulation. It is attached to the top of the tank so as to allow 3 ft. of variation in the water level. A number of crisscrossing cables keep the float from being lifted by wind forces. The tank itself is insulated by 1-1/2" of polyisourate insulation (R=12) laminated by a heavy aluminum sheet with baked enamel paint cover. This insulation is also covered by aluminum foil as a vapor barrier and the cavities are filled with a mastic. The sheets are held tightly against the tank wall by spring loaded cable.

The problem of inventory is solved by a unique metering system. Four booms are floating in the tank at a 90° angle to each other. Each carries six thermometers. Two of the booms are attached to the bottom and rotate (float) up against the disc and measure the cold section temperature. The other two are weighted and rotate down against the disc measuring the warm section. The rotation is electrically translated into height, and with four readings the position of the disc and its tilt, if any, can be determined and the respective volumes correctly calculated by the control computer. The operations are manually initiated and stopped but otherwise are computer controlled and supervised.

HOW TO UTILIZE STORAGE

A. Reduce the size of new plant

The more pronounced the daily peaks are, the more advantageous it is to build storage instead of purchasing machinery. Figure 6 shows the daily load curve of a large system on the peak day. The left-hand scale shows how the 13000T plant will reach full output for about three hours during this day. With a storage facility of 25000 T-hr. capacity this same plant is capable of providing an 18200 T peak. The machines will be utilized at or near to their full capacity for about 10 hours on that same day.

SAMPLE STORAGE OPERATION

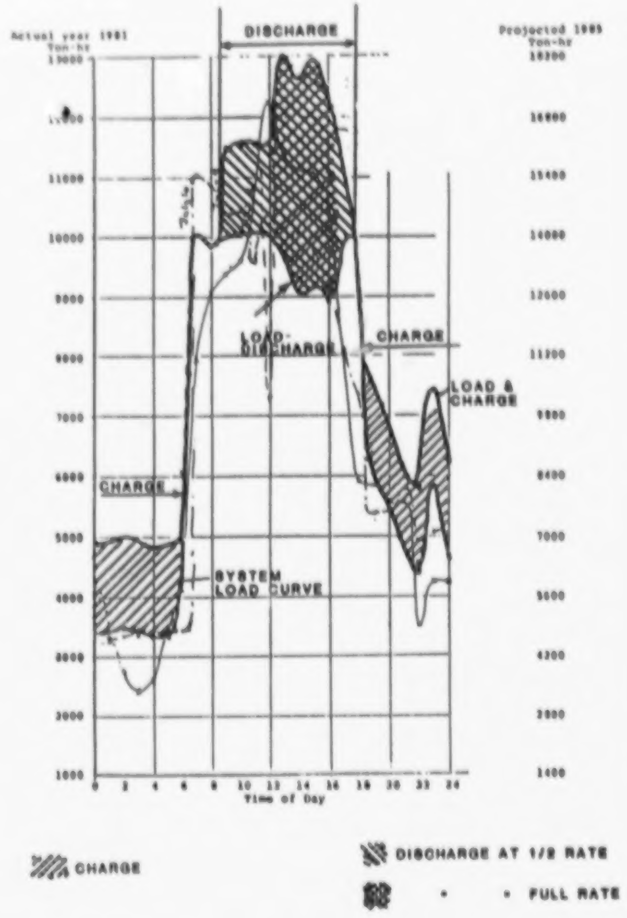


FIGURE 6

BEST COPY AVAILABLE

If the machines are electrically driven, obviously a far better utilization of demand charges will obviously follow, for considerable cost savings. When the machines are steam turbine driven, sustained even loading of boilers and reduced startup/shutdown sequences will improve fuel efficiency. These same considerations extend sometimes even more significantly over the night operation where the load increase may be even more beneficial.

B. Adding new load

Storage added to an existing system effectively extends its peak output at a cost lower than installing a new plant. It can also be used as an income generating measure. Going outside the confines of the campus one can sell service at competitive rates. This can be made even easier if the new user builds the storage at his premises instead of at the plant and benefits directly and immediately from reduced capital outlays. The connection cost can also be handled this way if necessary.

C. Extending the distribution system

Addition of new load is limited by the capacity of the distribution system sometimes. Either the velocities become higher than prudently acceptable or the pump work increases beyond the capability of the circulators and beyond economical operating costs.

A dispersed--that is, remote from the plant--storage facility can remedy any or all of these. The storage gets filled during the light load hours. The flows are normally low and the flow added to charge the tank requires little pumping power and is well within the head capability of the circulators. During the peak hours, flow from the plant is combined with flow from the storage. The storage at the remote point virtually shortens the distribution system the central pumps will "see."

D. Increasing the load on a distribution system

The same considerations apply as to the longitudinal extension of the distribution. The major difference is that the best location of the storage is not necessarily at the new load. The best location is on the hydraulically longest distribution branch and it should serve to equalize pressure drops among the different branches of the system with the new load included. This way the pumping efficiency of the whole system is improved, beyond just accommodating a new load.

E. Coping with a limited power supply

As plants grow over the years, even a power supply designed with foresight can be the limit to future growth. At this point replacement of cables, transformers and addition of primary switchgear would be a major expense. This may be compounded by lack of space. Storage with its minor power requirements could be the solution instead of addition of machinery.

Similar considerations apply to the steam driven plant where boiler additions would be needed.

F. Night tariffs

The shift of considerable power use to the night hours can qualify the facility to use electric power rates lower than summer peak day rates. These, where applicable, combined with the possible reduction of demand charges can make a storage installation economically feasible even where no system expansion is taking place. Particularly where the electric rates include a high percentage of rachet for the annual peak demand charge, as most do in the northeast, annual savings in the order of $35,000 per 1000 T peak can be achieved in power cost alone.

G. Efficiency improvement

Operating cost savings are an ancillary benefit, not a primary reason for installing storage. Some are well defined, as less fluctuation in steam generation, less start-up and shut-down of boilers and machinery or more even and higher loading of absorption chillers. Centrifugal chillers having very good partload efficiencies do not provide added savings unless they have variable speed drives.

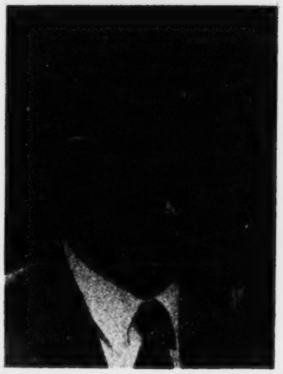
It should also be considered that the reduced or more even use of the plant machinery may reduce maintenance costs and extend plant life.

H. Cogenerated energy use

Cogeneration of power and heat is a concept having a rebirth. Its economic feasibility revolves around the availability of the heat sink. Any device which extends and evens out the heat sink availability helps that feasibility. Daily storage of chilled water certainly does that where the chw. is generated by steam driven machinery. While this can be an advantage under certain circumstances, it should not be considered as a blanket endorsement of this type of cogeneration.

SUMMARY

I do hope that the foregoing has succeeded in illuminating the importance of storage as a viable component of chilled water systems. It may pay handsomely to investigate how it fits in with your plans and apply the principles creatively for your system. Whether it is central or dispersed, aboveground or underground, makes use of head recovery or not, these are of secondary importance. The primary consideration is that in most cases economics will support the inclusion of such a facility into your chilled water system.



Local Area Networks

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History

The computers of the early days in 1950's ran in batch mode only. There was no direct interaction between the machine and program while it was running. The 1960's saw the beginning of interactive computer access with the use of "dumb" terminal connected to a central computer via a slow speed telephone line. With the introduction of versatile and relatively inexpensive minicomputers in 1970, the need for sharing data bases became more obvious. The concept of distributed processing, user to computer, computer to computer and long haul data communication technologies came to fruition. Long haul networks of many kinds and complexities were developed. Some of the major ones are as follows:

1. GEISCO (General Electric Information Services): It is the world's largest commercial data processing which serves over 5,000 customers in more than 500 cities in four continents and can be accessed by 90% of all free world business phone systems.

2. ARPA (Advanced Research Project Agency): It is the department of defense network which connects over 100 large computers all over the country including satellite links to Europe and Hawaii.

3. SITA (Societe International de Telecommunication Aeronautques): It is a cooperative of international airlines which provides communication capability to more than 60 airlines. Its backbone consists of nine computers which are located in New York, Hong Kong, London, Paris, Madrid, Beirut, Rome, Frankfurt, and Amsterdam, and are connected via medium speed lines.

Aside from the above three, some of the other major computers are Tymnet, Telenet, Ethernet, Euronet, Infonet, Aloha, etc.

The introduction of personal computers in the late seventies opened a new era in computing technologies. In the first years, personal computers were meant to be used on stand-alone basis. As PCs became more powerful and their use increased, the need to share common resources among different units in the local environment became more obvious. As a result, local area networks were developed and became popular. Therefore, Local Area Network (LAN) is a structured high-speed communication system with two or more communication devices connected within a limited geographical area.

Benefits of LAN

A local area network allows sharing of expensive Input/Output (I/O devices, such as letter quality printers, color plotters, mass storage, high-speed printers, etc., which minimize the duplication of output devices. Also, common data bases can be shared, making data updates easier. Moreover, its versatility lends itself for use in office automation.

According to a study by Booze Allen Company, more than 25% of professional time is spent in clerical activities such as filing, copying, and retrieving information. On the average, only 26% of phone calls, with an average duration of about five minutes, were successful on the first try. Therefore, professionals spend about 1.9 hours per day on the telephone, while the information exchanged requires only seconds. It was shown that office cost is 40-50% of a total company's cost, and clerical cost is approximately one-third the cost for managers and technical professionals. LAN used for automation can reduce office expense greatly.

The other motivation for using LAN is the relative cost of data transmission for electronic data processing (EDP). For example, in 1977, 40% of total EDP cost was for hardware, 17% for software, 30% for salaries, 5% for supplies, and 9% for transmission costs. Presently, 12% of total EDP cost is for hardware, 20% for software, 32% for salaries, 10% for supplies, and 26% for transmission costs. This means that, next to salaries, transmission costs are the largest item in the total costs. Also, studies have shown that in most cases over 60% of communication is within a building, with approximately 25% within a 50-mile radius and only 15% more than 50 miles. This means that with a LAN the communication costs will be cut less than half.

In addition to the above, a LAN versus a centralized system offers simplicity and flexibility. The system can grow linearly as needed by avoiding the initial cost of a central processor. The failure of hardware and software in one node usually affects only one station. It is easy to reconfigure, expand, and tap to the network. This ease has made it virtually impossible to secure for intrusion. With the current state of the art, security is a drawback with all LANs.

Before elaborating the application of LAN, let's briefly discuss some of the technical concepts related with LANs:

Topology. This refers to the geometric arrangement of the links and nodes. A node can be an input/output device or a computer. A link is the data communication path between nodes. There are three basic LAN topologies: star, ring, and linear bus. For star topology, if the central node fails, the whole network ceases to function; however, the failure of individuals does not affect the rest of the system. The system throughput and maximum number of nodes are functions of the central node capacity. The network has a high initial cost, but low incremental costs for expansion.

In a ring topology, the nodes are physically connected in the form of a closed loop. Therefore, if a node fails, the entire network fails unless there is a bypass circuit. The network throughput reduces as additional nodes are added. The system cost per station is lowest in comparison to the other topologies.

For linear bus there is a common line with every node hanged from it. A failure of one node does not affect the rest of the network. Nodes can be added or deleted without any reconfiguration. The cost is higher than ring topology, but lower than star.

Transmission Path Establishment. Before a message is transmitted from a node to another node, a data path must be established. There are two major techniques, namely circuit switching and packet switching. For circuit switching, a communication channel is set up first, then used exclusively and continuously during the entire communication period. Normal voice communication is based on this principle because the communication duration is much higher than the time required to set up the path.

Unlike voice communication, data communication requires bursty and short intervals. Therefore, circuit switching is very inefficient. Packet switching is the answer. Here, the message is divided into standard lengths called packets, with a message header and message trailer. There are two varieties of packet switching, namely store, forward and broadcast type. Usually LANs uses the broadcast type.

Channel Allocation and Access. Data communication channel is usually allocated by time division multiplexing and frequency division multiplexing. For time division multiplexing, unique time slots are allocated for every node to transmit data for the entire channel band width. Conversely, in frequency division multiplexing, every node can communicate any time, but each node is allotted a unique part of the band width.

The communication channel can be accessed by a centralized polling or distributive polling system. Centralized polling is a deterministic approach used if the communication pattern is known with a good degree of certainty. Distributed polling is a probabilistic method where data is transmitted by nodes at random. There are two types of distributive polling, namely token passing and CSMA/CD (Carrier Sense Multiple Access with Collision Detect).

In the token passing technique, a free token is passed on from one node to the next. When a node has the token, it has control over the network and can transmit data for as long as it wants. When the data transmission is completed successfully, the token is passed over to the next node. One drawback of this technique is "hogging," where a certain node might control the network for long periods of time. One way of solving this problem is to use the slotted rings system, where a number of fixed frames are used to carry data from the source node to the destination.

The CSMA/CD technique is based on the idea of "listening before talking." When a node wants to transmit data, it listens to see if the channel is free or busy. When it finds the channel free, it broadcasts the data to the entire network. When the receiving node sees the address, it receives the data. If more than one node transmits simultaneously, there will be a collision and all transmitting nodes will stop transmitting and attempt to retransmit after a random delay. CSMA/CD works well for less frequent long messages, while token passing is more appropriate for short and frequent messages.

LAN Standards

Unfortunately, with all the technical advances that have happened in the past few years, LAN standardization has not kept pace with technology. This is one of the reasons that LAN has not been as popular as it could have been. Standards are necessary to establish hardware independence from network design and to establish standard software protocols. The lack of adequate standardization has resulted in closed propriety systems, lack of sufficient competition, and the rise of defacto standards. The agencies which have been involved in standardization of communication are:

1. National Organizations: ANSI (American National Standards Institute); CBEMA (Computer and Business Equipment Manufacturing Association); EIA (Electronic Industries Association); ADCCP (Advanced Data Communications Control Procedure); and IEEE (Institute of Electrical and Electronic Engineers).

2. International Organizations: IEC (International Electrotechnical Commission); ECMA (European Computer Manufacturers Association); IFIP (International Federation of Information Processing); CCITT (Consultative Committee on International Telegraph and Telephone); and ISO (International Standards Organization).

The principle groups involved in standardization are IEC, IEEE, and ISO. ISO has 80 country members in its 150 technical subcommittees. They have developed a seven-level communication model called Open System Interconnect (OSI). The OSI model starts from basic hardware compatibility (level one) to full compatibility and system transparency to the user at level seven as follows:

Level 1 - Physical. Deals with physical circuits and pin configuration. Example: RS232, X.21, etc.

Level 2 - Link. Deals with addition addresses to outgoing messages and decoding incoming messages including error detection and correction. Example: HDLC, SDLC, etc.

Level 3 - Network. Deals with adding network addresses, routing control errors, and packet assembly/disassembly. Example: X.25, NCP, etc.

Level 4 - Transport. Allows computer systems to interface with the network. This software interfaces between the first three layers.

Level 5 - Session. Involve a boundary between network functions and application functions. Example: Signon.

Level 6 - Presentation. Deals with translating languages, data formats, and codes between terminals. Example: File transfer protocol.

Level 7 - Application. Computerization process to generate or receive and interpret messages. Example: Database, time sharing, etc.

The above model is flexible enough that many different networks can be designed to meet the overall intent of this framework. So far, OSI has specified the first four levels. Further work is needed to standardize the other three levels.

Internetworking

After a LAN network is operational, it becomes necessary to be able to interact and communicate with other LANs. The idea is to be able to make it as user transparent as possible. There are two products which are used for internetworking, namely bridges and gateway. A bridge is used when similar networks are connected and a gateway is used for connecting dissimilar networks.

LAN Selection Criteria

There are over 250 manufacturers of LAN products. The lack of adequate standardization and the rapid pace of technology makes the selection of the appropriate system very difficult. However, it is attempted here to give some guidelines which can make the process easier by asking the following questions: (1) Can the network handle projected volume of traffic within accepted time delays? (2) How easy is it to add new equipment and application? (3) What type of information, i.e., data, voice, video, etc., can be handled by the network? (4) Is the network media twisted wire, coax cable, fiberoptics, or microwave? (5) Is the network base band or broad band? (6) To what degree does the network comply with the ISO seven-layer model? (7) Can it be internetworked with other LANs? (8) How much is the yearly maintenance cost and what level of local support is available? (9) What level of training is available? (10) Does the system throughput, error rate, delays, reliability and security meet your basic requirements?

As mentioned earlier, there are many LANs which are commercially available. Some of the popular ones are: PC net, Novell, Ungermannbass, Ethernet, Omninet, Nestor, etc.

LAN APPLICATION AT THE UNIVERSITY OF CINCINNATI

Overview

About five years ago the University of Cincinnati Physical Plant looked into the possibility of introducing computers into the daily administrative activities of the department. This was in part due to the lack of receiving any response from the University Computer Center. It was decided to address the department's computing needs with a stand-alone system. Various minicomputers were examined, but every approach was found to be expensive. However, the cost of personal computers was sufficiently small enough to allow its purchase and use as a prototype. This was a big breakthrough for the department.

In 1981, a TRS-80 Radio Shack was purchased and initially used for energy audits, engineering applications, word processing, utility billing calculation reports, and spreadsheet programs. Two years later, in March, 1983, in the light of the previous success, a more ambitious project was undertaken to computerize the business functions of the department using PCs. In fact, the way this project was perceived and implemented was not only a success by Physical Plant standards, but by the standards of any other department on campus.

The first phase of the project was to computerize the work control operation, using three IBM PCs to work in unison. Therefore, a Local Area Network was chosen. Also, the computers were able to handle the online dynamic work environment. The system became operational in July, 1983. By October, 1983, the second phase of the project, to install the network throughout the department, began. By March, 1984, the physical network was installed in all of the departmental central offices at Campus Services Building. This constituted the installation of conduits, coaxial cable, and wall outlets. The network was configured in such a way that future node addition could be implemented easily. The system became operational in May, 1984. To date there are over 10 computers connected to the network, sharing common application programs and common data bases. The primary network storage device is an 84-megabyte hard disk, tapes, and floppies, which are used for data backup. The following application programs have been developed so far:

Preventative Maintenance. This is the second sybsystem of the work control system. Preventative Maintenance refers to the automatic issuing of work orders on routine PM work weekly, monthly, quarterly, and annually.

Inventory of Materials. This system automates the record-keeping functions of all the materials going in and out of the stockroom, maintaining an accurate record of the value of the material on hand and determines material reorder points.

Time Card and Personnel Records. The system is made up of data collection, calculation, and payroll verification report generation. Also, it keeps personnel records on items such as the time the employee has been working for the department, distribution of time on different work orders, and personnel data.

Aside from the above application programs, the following projects are under way:

Buildings and Grounds Report. This requires the integration of the first four systems. It will develop reports on maintenance cost per square foot data for all academic facilities. This phase is about four months away from completion. The second phase will be the integration of utility cost data to get the total building cost per square foot data.

Billing. There is some maintenance work performed by the department and this is charged against the department requesting the job. The necessary information will come from the work control system, which keeps track of the job requested. In addition, labor cost and material cost will come from the time card and inventory system. This system will be operational in six months.

Future Projects

In addition to the above, the following are some of the systems which are under consideration and are presently at different stages of development: (1) budget control system; (2) teleprocessing for department satellite offices; (3) LAN integration with DDC temperature control system; (4) internetworking with other departments within administrative services; (5) office automation and electronic mail; (6) computer aided instruction and design (CAI and CAD); (7) implementation of PERT/CPM for construction projects; and (8) implementation of operation research application for department processes.

Conclusion

The department computer strategies encompass many phases, steps, and stages. The implementation of LAN with PCs has given us the chance to grow linearly without major upfront costs, but with a great degree of flexibility. Because of the qualitative and quantative experience acquired throughout the development of our computer strategies and LAN implementation, the department is in a technically favorable position with respect to other departments on campus. And, the LAN has proven to be an organic part of the departmental computerization strategies in the daily administrative and technical functions.

Nuts and Bolts of the Plant Personnel Team

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The need for the training and development of employees within a physical plant department has been well documented through other APPA conference presentations, journal articles, and most recently the newest edition of Facility Management. These have covered the "why" but not the "how".

The intention of this paper is to review the basic ingredients of a training and development program. The examples are actual events that have taken place during the first year of our start-up at Duke University. Many can be low cost, some are splashy and all are purposefully intended to be time effective and low maintenance.

I was hired last June to set up a training program and improve employee communications. Operationally I coordinate a comprehensive employee development program -- in short, to improve morale and motivate employees. Secondly, I manage eight training programs -- one for each of the six components of the Duke University Physical Plant department, the supervisors, and the managers.

Training and development is not only an issue within physical plant administration, it is also a national issue. In 1982, the American Society of Training and Development completed an in-depth study on training and development and its impact on economic growth and productivity. The final report, Human Capital, concluded that an organization's greatest resource is its employees. The study graphically illustrates the impact of training on the quality and quantity of work. It points out, for example, that

> In 1890, resources from the earth including minerals, energy and food accounted for more than 50 percent of the GNP. Today human resources have grown to account for more than four-fifths (80 percent) of the nation's economic output.

The study suggests that skill shortages, shoddy workmanship, and the reduced quality of the work force itself are a direct effect of our failure to update the labor supply. It also goes on to propose that increased human resource development will be the dominant force in increasing productivity and will cause a positive impact on economic growth.

Consider These Grounds Rules Before You Begin:

1. Start slow and build credibility. A good program may take three to five years to build. People are creatures of habit and often resist change. Just as you couldn't fix every faucet on campus at the same time, all employees cannot be trained simultaneously. It takes time to see demonstrable results.

2. Training is not a cure-all. Training and development programs will not resolve personality problems, increase workers IQs or compensate for poor equipment.

3. Know when to be flexible. Recognize that good ideas don't always work. You will want to set a trial period, say a year, for a particular project.

"Training" here is defined as instruction or skill building to enhance an employee's ability to perform his job and "development" means improving the employee's personal regard for himself and his employer. While these are different processes, they do dovetail each other. Both are needed for the success of the other.

Development of a comprehensive training and development program includes: (1) Determining needs and priorities--find out what training is desired and evaluate the attitude of your employees, (2) **Assessing Resources**--inventory what materials and equipment you have on hand and who will train or coordinate development programs (3) Developing short and long range goals--look at priorities and set up a game plan, and (4) Tracking results--design a means of evaluation. Time spent devising plans will pay dividends. The payback comes in fewer false starts or failures.

Determining Needs and Priorities

Performing a needs analysis is much like writing up a preliminary "spec sheet" or blueprint. You will need to determine what or whose needs are to be evaluated, what information or data you want, what method(s) you will use to collect the data, how you will evaluate the data and then who will actually do the needs assessment. Many good references exist for conducting a needs analysis.

Solicit input independently from management, supervisors, and employees. You will see patterns develop and see some overlap of information. Like concentric circles, your target need will appear as the center of the three circles. Each response standing alone may be valid but the center area will be more specific.

The two most common methods are the written questionnaire or individual interview. The written survey asks for specific information and may be administered to each employee or a representative group. A word of caution on questionnaires, you may not always get the answers you wanted and may even get some unrelated responses. It may also not get at the "why"--the reasoning behind the answer. The individual interview is time-consuming and with a large organization it is probably impossible to survey everyone.

In our own situation, I used individual interviews with the managers and supervisors and group interviews with the employees. The group interview, as a third option, can with some practice provide not only specific information, but also some of the "whys" in a short amount of time. It allows the group to "own" the ideas. When employees see their own ideas realized as part of the training program, it definitely sparks their interest in training. We found that employees took these meetings very seriously. If you use this option, keep to your agenda and let someone else keep notes. Make sure you let your employees know the results of the needs analysis. (See Appendix A for a list of needs analysis questions).

Assessing Resources

Financial - What can you afford? I strongly suggest determining what you want to do first, and then look at alternative ways to accomplish your goals. Once you have some ideas, consider who will coordinate your efforts, what support staff is available, and what equipment you will want to buy (slide projector, video playback, A-V materials). You may find these are available for free or for a nominal fee at your school.

Personnel and skills - The ideal situation is a full-time trainer with support staff help. Smaller schools may be able to utilize existing human resource department trainers or share a position with another department.

1. Must the person responsible for training be a bonafide trainer? No, but that individual must be committed, creative, and resourceful. It is essential that this individual have management support. If the person is not full time, s/he must be able to delegate well and closely manage the program.

We tried for 5 years to run a volunteer managed training program that fluctuated from OK to disastrous. A key element to our success has been having one staff member who clearly is responsible and is given the job as a high priority assignment.

The American Society for Training and Development points out that productivity is tied to employee development. Preventive maintenance and capital plans are sound management practice -- so is training and development. As you consider your own training program, think how often you have spent extra time or dollars because someone was careless or did not know the best way to handle a project.

2. Where do individual trainers come from? Everywhere. They need to have a broad base of knowledge about the course they will be teaching. They need to be able to recognize that adults learn differently from children. They must also have good presentation skills. Interview every trainer before s/he begins a class even if that individual works in your department. Here are some possible questions.

a. What are they going to train employees to do? What do you want your employees to learn? Course content is your discretion. It is negotiable--you should not feel at the mercy of the trainer. After discussing what your employees need, ask for a written outline with specific topics to confirm course content.

b. How do they plan to teach? Adults retain more information if they hear, see and practice a new skill. Your instructors should vary how they present the course material.

c. Where have they taught before? Ask for references and check them. Sit in on the first class and feel free to cancel if it is not what you contracted for. Bad training is worse than no training at all.

d. Can we make the information relevant to our employees by including our own blueprints, machines or case studies? This should not be a question but an expectation.

3. Can you use your own people? Definitely. Your own inside people may make excellent trainers with some guidance. In fact, your supervisors and managers train or coach employees every day. **If you have no time and limited dollars for any other training, using your own managers and supervisors gives you savings.**

4. Training away from home. Literature on the wide array of seminars, classes, and workshops cross our desks each day. Reputation or referral are still the best ways to decide which one is best for your department.

Training materials - First, look at what you have on hand. Most of you probably have TPC manuals, photos of projects before and after, films, repair manuals, etc. Pull all of it together in one spot and see how that information can be integrated. Repair manuals can become the basis of training manuals;--some of the line drawings can be enlarged on a copy machine and made into transparencies. Use old equipment for hands-on experience and problem solving to test your employees on how fast they can tear down and repair or diagnose the piece. Slides can become Audio-Visual materials specific to your own school. While there is a lot of good technical training material on the market, much of it is too expensive to be purchased or rented for the small handful of employees in one particular craft area.

Class space - Choose space that can have more than one use. For example, folding tables and stacking chairs can make a shop a classroom. Larger schools may be able to allocate space for a classroom conference area.

Networks - I am indebted to my counterparts at the University of North Carolina-Chapel Hill and North Carolina State University for their advice and counsel. The local ASTD chapter also provides many free resources. Most trainers will share their own in-house manuals. Trade groups or vendor/sales representatives can provide generic training if you work with them and spell out your needs.

Developing Short and Long Range Plans

At Duke's Physical Plant department, we found many employees had inadequate educational backgrounds and most learned their crafts on the job or were self-taught. They also lacked self-confidence. Working in a large university environment, they often saw themselves as just a number or an insignificant cog in the system. Some mistrusted management, seeing only an "US-THEM" situation. Also, past training had been sporadic or of poor quality, so employees were leery of yet another training program. In response to these factors, we decided to emphasize our development programs first. By increasing employee morale and bettering communication between management and employees, we felt employees would be more responsive to training.

Employee Development The employee development program consisted of four projects. They were a formal communication network, social events, informal communications skills, and showing recognition.

The communication network project utilized three vehicles--revamping the bulletin boards, restarting a department newsletter, and setting up a suggestion program.

Existing bulletin boards were crowded, empty, dirty, or outdated. We surveyed the locations of all bulletin boards in use and pinpointed those in high traffic areas near our personnel. We relocated some or added new boards so they were a consistent size. The bulletin boards were spray dyed navy blue, Duke's school color, and printed headings on bright yellow backgrounds were added. These changes greatly increased visibility. We asked supervisors in 16 central areas to act as contacts to check for vandalism, timeliness, etc. Monthly inspections insure consistency. Our results have been very positive. We have had no vandalism, receive ideas from employees on the boards, and find that our employees really do read the information. A side benefit has been that our clients--students, faculty and administrators--read them, too.

In starting up our suggestion program we printed up both a suggestion form and an awards certificate, set-up guidelines and policies, and established a budget for awards and a committee to evaluate the suggestions. We knew our employees had good ideas but they tended to keep them to themselves. Initially, the response was slow but in our fourth quarter it has picked up considerably, both in quality and in number of suggestions. We have not yet saved a great deal of money. Mostly it has pointed out things we thought we already did. Many relate to safety and these alone are worth the cost of the program.

Each entrant receives a "thanks for your idea" and a "here's the results" letter. Awards are made each quarter and include gift certificates (for goods purchased on campus) for $50, $25, $10 or a certificate of merit. The employee's picture or name is also published in Shop Talk, the Physical Plant department's newsletter.

One problem with the suggestion program has been tracking the suggestions once they have been evaluated. Determining results was difficult. Once 10 to 20 suggestions got into the system, it started getting complicated. The solution was to convert the necessary information to Lotus 1-2-3 software for record keeping. Now each manager gets a monthly print-out listing those suggestions within his component area that need action.

The department has had several newsletters over the years. Our latest edition is automated. Copy is entered on a word processor with Kroy letters for print headings and lots of pictures. The pictures boost employee morale. The first issue surveyed employee interest and included a contest for the newsletter title. At first, articles came from interviews with employees or managers. This coming year reporters will channel back articles for the newsletter. Short articles with an emphasis on human interest, and on content will make it employee-directed.

Social functions have played a significant part in our employee development program. We held two department-wide activities--a Christmas luncheon and a picnic. The Christmas luncheon was held in our finest banquet area on campus with managers serving employees. An annual picnic serves to introduce us to our employees' families.

Informal communications means just plain talking. Misunderstanding, misinterpretation or poor listening cause bad feelings, cost money and slow down the system. We knew that active listening opens channels between management and employees, and learning to "say what you mean" could cut down on communications problems. These were seen as both informal contacts with employees and thorough regular meetings.

Supervisors meet monthly with employee groups in a roundtable format to generate feedback from their employees, but supervisors had not received training on how to run this kind of meeting. These meetings had deteriorated. Supervisors now receive specific training on better methods of handling criticism and negative comments. The intention here is not "touchy feely" but to get supervisors to hear employees' concerns before the mole hills become mountains.

Also, the Physical Plant Director has held meetings with each geographic or component area, to break down the barriers to better communications.

Public recognition such as certificates and awards acknowledge the employee for a job well done. These instill employee pride. Piggybacking on existing University programs is a good example. When the University gave out five-year service awards certificates to employees, we invited these employees and their supervisors to a coffee hour and individually applauded their contributions to our goals.

The key element in each program is employee input. For example, the Suggestion Awards Committee is mostly made up of employees, with some management input. We have tried to reinforce to the employees in as many ways as possible that You are Important.

So You're Going to Teach an Old Dog New Tricks - Training Employees

1. Upfront issues - Knowing that productivity or quality could be better is one thing, actually doing it is not so easy. Training can be one answer, but consider these issues first:

a. Motivating employees to learn. What will the payoff be to them?

b. What past training/education have your employees had? Are any of your employees illiterate?

c. Is productivity or work quality a training problem or is it related to morale, work conditions or supervisor/employee relationships?

d. What standards exist? What do you consider the basic skill needed to do the job and does it fit the job level?

e. How do employee measure up to these standards and who will determine what deficiencies exist?

f. How many hours can or should your employees be away from their jobs to be trained?

Set training priorities within a specific time framework. The best bet is to allow foremen and employees to suggest the what, when, how often, and who goes. Then work out the best method of implementation with management. Also encourage employees to volunteer. Mandatory training gives the message--"you screwed up."

2. Look at all your resources for trainers. Contributions to your program can come from--campus human resources or personnel trainers, sales or manufacturer's reps, local technical colleges, high schools or community education programs, private institutions, and your own departmental trainers, managers and supervisors.

3. Look at all your employees' needs. Your managers and supervisors want and need training too. For over two years we have held monthly personnel management lunches. Each manager takes a turn giving a presentation on a topic of his choice. These have ranged from labor relations to evaluating resumes to stress management. A bi-annual staff planning session is also held to review goals, bolster team image, and/or do short training sessions.

4. Develop your own training resources. Supervisors are coaches. Your supervisors coach employees daily as they oversee the employees' work. Consider offering a coaching workshop for them. Coaching includes four simple steps--describe the task, demonstrate, allow the employee to practice, and give helpful feedback. Videotaping practice sessions will increase their skill. Your employee/supervisor communications will improve and your supervisors' credibility will rise.

a. Employees as trainers. With advance preparation, your supervisors and skilled employees can become part of your training program. Find out who is interested and who can be a trainer. If this person will have responsibility for classes, send them to one of the many new trainer workshops given around the country.

b. Use a doer and a talker. Not everyone can stand in front of a group and train. Consider pairing a technician with someone to translate the technical jargon, interject good questions, and keep the class moving. Another option would be to videotape a skilled craftsman performing the task without an audience and voice over the tape. Invite the craftsman to the class as the "technical" expert. Promote this as an honor and offer this opportunity to all your best people.

c. Consider free sources of training such as county extension officers and vendor/sales representatives. Be sure to let them know upfront what you expect. Be specific. Simply asking for a basic course in electricity is not enough; be sure to spell out what you expect employees to be able to do after the course. Find out if the sales rep has been trained by his company as a trainer (many are) and if he knows generic information and application.

d. When an employee goes away for training turn your investment into a training event for others by asking that individual to brief his/her work group upon return. (Be sure to advise them of this beforehand.) This helps that individual review what he learned and pass on the information. Make sure you get a copy of the material he received during the training, so that information can become a reference and be used with other employees.

Tracking Results

Determining the impact of your investment is an important element of any comprehensive program. A combination of both subjective and objective measures is best. In our own situation, each participant is asked to complete an evaluation form; this and all class work information is recorded into a database set up on Lotus 1-2-3. We can then easily determine who by component or total department has received training, what courses have been offered, the total hours, and the cost of training including manpower costs. Using Lotus 1-2-3 graphics, we can also get a visual summary of the overall program. I make a practice of asking some of the participants outside of class what their impression of the class is. I also ask selected employees what they learned a few weeks after the class.

Another option is to ask a neutral party to evaluate the training. We have a University management intern, who has been asked to both survey and informally interview employees on our program.

And finally, the cost. This program in its entirety or parts of it can be done at little expense or can become a very splashy program. We have decided to take a middle of the road approach. We have spent money on those things we felt would have a good return on investment, that were highly visible and could be done well without becoming a burden. Many of these ideas can be implemented with good support staff help. In fact, most of the courses we offered this past year have been free. The communications network project has involved the use of a copy machine, construction or colored paper, camera-ready copy for the newsletter and some clip-art--all quality but low cost alternatives.

At a recent conference I heard one of the speakers repeat a comment made to him, "If you think training is expensive, think about how much incompetence costs." I hope your choice will be to invest in your employees.

APPENDIX A

NEEDS ANALYSIS QUESTIONS

1. What training has taken place in the past five years? (This would include course titles, instructors, how a course need was determined, class location, dates, who participated in each class, and evaluations of the class)

2. Who did the training? (Specific details about the instructors, how well they were received, and what courses they may be able to teach.)

3. What training materials have been used before? (This would include not only those that you own but also those that had been rented like movies or videos. How did participants or the instructors like the materials.)

4. What skill standards exist for a particular craft? (Look for statistically validated tests; these are more likely to be unbiased. If you do not intend to use competency testing for promotion or wage increases, but instead to determine skill levels for training, you may determine your own competency levels.)

5. What priorities exist? (Short and long term priorities should be established. What is your immediate need and what would you like to accomplish over the next year?)

6. What seasonal work loads exist? (This will determine when you can schedule training programs and when you might want to schedule refresher courses.)

7. What are the educational backgrounds of your employees? (You should find out before you start a class if you have any participants who cannot read so you can make arrangements to accommodate them during the class.)

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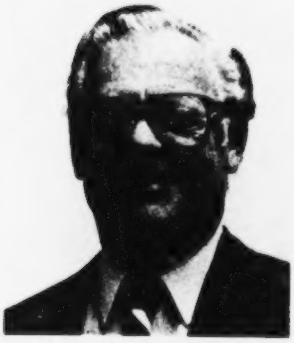

Maintenance Management - Credibility or Fantasy?

By Robert S. Hunt
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One of the major challenges facing all Plant Administrators is the establishment and maintenance of credibility of your operations. How often do we hear raised questions such as - "Your costs are too high", "Your workmanship is shoddy", "If you want something in a hurry don't call Physical Plant", "Physical Plant takes too long", "All those blue shirts do is sit around, I never see them working", "The Plant Director never returns my phone calls", and on and on, ad infinitum and ad nauseum.

One sure thing you can bet on, when resources start to tighten up, more critical eyes gaze at the plant operation. Neither a large institution, a small institution, a private or a public institution escapes this scrutinization.

What are we doing about it? What can we do about it? Simple questions with complex answers.

First, do we really know what's going on at our places of business? Sometimes I'm afraid we don't. Many of us too often rely on "normal" channels of communication. Too often, also, these "normal" pipelines of communication become clogged or, worse, filtered. We make a mistake to put total reliance on these means. One sure way to know what's going on is to establish your own "intelligence network".

Get out from behind the desk and tour your campus. Stop and visit with members of the campus community. A few minutes with a Dean, a faculty member, a key administrator, a student, yes, even one of your own custodians - can be time well spent. Of course, there are more formal ways to do this. This would be by way of special surveys of key people at your campus on all ranges of your services - custodial cleaning, maintenance efforts, renovation activity, and so on.

Additionally, if you have not already done so, establish a plan to improve your maintenance operations. This starts with maintenance management itself - with the procedural and responsibility functions of management. These basic functions are: planning, scheduling, doing, measuring, reporting, and correcting.

I would like to quote from APPA's own "Facilities Management" manual:

> Excessive reliance upon past practices, outdated procedures, and the resistance to change in the maintenance management field result in lower productivity and higher costs. New maintenance management systems and techniques makes it possible to increase the productivity of people and reduce costs. Progressive maintenance management has advanced far beyond breakdown maintenance and fighting fires. It now includes management systems for requesting and authorizing work; planning, estimating, and scheduling work; performance measures and controls such as work sampling techniques; and cost accounting systems designed especially for controlling maintenance costs.

Some other ideas I'd like to offer for your consideration are contained in the "Check List" before you. Most of these have come from successful Plant Administrators throughout the United States. Do give some thought to them. If you implement any of them you may be pleasantly surprised with the results.

I do not wish to offer any panacea for this credibility problem. But, I can say most assuredly, that your honest and sincere efforts to put into place a plan based on any or all of these suggestions will pay off. The knowledge on the part of your peers on campus that you are doing something taking a positive role - will be 50 percent of the battle. Remember - the quality or power of inspiring belief - that's credibility!

I would, this morning, like to concentrate on one paramount area that clearly dictates whether we succeed or fail as good managers. That area is our ability to effectively work with our superiors and our subordinates.

It is not trite to proclaim - "we are as good as the people working for us". Your ability, in the first instance, to choose good people for key positions is of course important. What do we mean by "good" people? Besides possessing the needed technical expertise, we should look for creative people, for people not afraid to express their opinions, for people who have a proprietary feeling about the place in which they work. In other words, perhaps, a good substitute for your job. We need to coach these people once chosen. We need to become a mentor - we need to encourage - we need to delegate with accountability. We need to demand the best from these people. They need to understand and share the same committment as you regarding efficiency and productivity. What about your organization? It's safe to say there is no one set way to organize a plant. Much depends on your mission and the peculiarities of your institution. However, I strongly suggest you first organize by "function" - then fit the right people with that function.

In spite of having technically well qualified people, many plant organizations have difficulty moving forward to more effective control over their programs and resources. The principal reason is that many organizations suffer from an overdose of tradition. Many plant departments are still organized much as they were a generation ago, as almost pure line organization - a group of shops, each headed by a supervisor who reports directly to the Plant Director. The personnel are well qualified technically in their trades but are not up to date on managerial techniques. Nor is there any type of staff support to bridge these gaps. The condition persists because it is hard to persuade top management of the wisdom of increasing overhead by adding staff positions in a "non-productive" department.

It is usual to find that when, in a traditional line plant department, a suitably sized staff of qualified professionals has been acquired, at a cost of an equivalent journeyman, the performance level of the organization has jumped 50 percent or more, and responsiveness has increased many times. Furthermore, operating and cost data have become available where there were none before.

Each box in your organization chart must have people in it, but each should represent a group of functions which must be performed if the enterprise is to prosper, and the interrelationship of the performing individuals should follow the structure of your chart.

The key to success in almost any management improvement is in the "who" as much as in the "what" and "how", and, in this day of highly developed personnel systems, and big unions, the way we are organized not only determines to a large degree how effectively our key personnel can function, but also has a lot to do with the caliber of person we attract to a given job.

Let's look at your superiors. We need to know and attempt to understand these people. We certainly need to appreciate their problems. Likewise, we should not be timid in sharing our problems with them. The more these people are informed of your operation the better off you'll be. In all encounterings be sincere, be honest, be tactful, be understanding. Above all else be "loyal".

In the course of an ordinary day - a Manager spends an extraordinary amount of time meeting and talking with people.

Part and parcel of the Manager's communication are the imagery, the place and the body movements that he or she uses. Images, setting and body language are not just adjuncts to communication. They carry the messages, and indeed, in some cases they are the messages. As such they are extremely important to us.

When you pay close attention to the words other people use, you notice that most people draw characteristic verbal pictures of themselves and the world around them. The imagery and metaphors that a person most frequently uses can be clues to understanding the world he or she inhabits. These vivid kernels of speech are drawn from the sports world, from literature, from religion and other fields of personal interest or background. The imagery shows what's valued, what's feared and what the speaker's behavioral rules are.

Consider these examples:

> "What we do here is drop back five and punt"
> "I am prepared to wait until hell freezes over"

A recurring use of metaphors might suggest that a person sees life in the organization as a game or is fatalistic about overtones. Metaphors can reflect an optimistic, a pessimistic or even a confused outlook.

Much of the communication between two people, however, implicitly involves sentiments and feelings. These feelings are attached to the different experiences that words connote for an individual. A typical conversation bumps along without either party paying close attention to the different experiences and, therefore, the different meaning that lie behind the words. We tend to assume that we are all referring to the same thing when we say "the boss", "a good report", "a viable alternative", and "a workable solution", but most likely we are not.

The emotional baggage that words carry shows up in other ways as well. In our organization, recently, two of our Managers disagreed about the best way to approach upper management for funding a capital project. On the one hand, the Engineering Manager wanted to "provide a menu of options". He wanted not only to give some choices but also to specify the range without dramatically posing the stakes. By using the word "menu" he was saying, in effect, "after all, everybody has to eat something - the question is what?"

On the other hand, the Construction Manager wanted the company to "bite the bullet." He wanted to challenge Management to do it right (provide funding) or not to do it at all. Complete with the overtones of the American Wild West his phrasing depicts a situation in which a big step - even if painful and risky - was necessary for the long term. In both cases the Managers are using words as emotional flags - their phrasing expresses very different sets of assumptions, value and understanding of company policy, mission and philosophy.

Depending on who they are and what kind of interactions they want with others, people use physical spaces in distinctive ways. Yet, quite frequently, we are unaware of what is being communicated.

Let's take a few moments to look at these photocopies (show photocopies of different executive office layouts and discuss the "traditional conservative", the "partcipative", the "contemporary".)

A few words about body language. They send nonverbal messages. Let me cite a personal experience. While a Plant Administrator at a large University I served on the Commencement Committee. This committee was composed of five separate college heads, (each jealously holding to a format of separate exercises), and chaired by my boss, the Vice President for Finance. The chairman, throughout the meeting, visibly showed anger that he was unsuccessful in getting agreement to one exercise - not five - and, of course, was concerned about the relative higher cost in separate exercises. As I was outlining what five separate commencement exercises meant in terms of plant support - and I was doing this in narrative style - I heard the chairman break his pencil between his fingers. That sound was like an alarm going off. I quickly stopped my verbalizing and, instead, took out of my briefcase an analysis pad. I showed the paper - with all its entries as to unit costs per function - and immediately the Chairman cooled down and proceeded to analyze his predicament. The point here is that the Chairman was "comfortable" with figures on an analysis pad. The sequel to this is that in all of my future dealings, in my normal duties, with this man I carried analysis pad sheets with me and always attempted to express to him, whatever the subject, in terms he could better understand - dollars and cents.

The manner in which a person stands, sits, walks - all radiate "messages". With a little practice we can "read" these messages and be more effective with our own words and actions. Many businesses today are devoting specialized training sessions on these subjects. The current term used is "transactional analysis". The important thing here is if we are to be more effective, and therefore establish better credibility, we must learn to use all of our talents in the communication process. It is, after all, the process most of us spend most of our time doing!

In this short time, considering the magnitude of the subject, we have briefly covered:

1. How vital it is to measure your departments' credibility.

2. That we all need to seriously address the questions of credibility and develop a plan to attack it.

3. The need to know what is really going on with particular reference as to "how others perceive us".

4. The importance of a good working relationship with subordinates - that they are key to our success.

5. Finding ways to understand, know and appreciate those we work with and for.

6. The need for an effective communications program - with your peers, subordinates, and your superiors.

7. The desirability of instituting systematic work scheduling and control.

There is one remaining key and critical element - US! We need to stop, now and then, to measure our responsibilities. Think about them in relation to the importance of our institution. Think how much the whole educational process hinges on our ability to succeed. Think how really important we are! Our profession is important - and the degree to which we learn and practice will reflect considerably on the success of our department and our institution. If we wish others in our work place to agree depends on our perception of our role. We will need to exude, to radiate, our feeling of professionalism, of knowledge, of pride, to these people. We need not be boastful but honest and sincere - confident in the work we and our people are performing. If we can reflect this confidence in our verbal exchanges and written communications with others - we can maintain credibility. It will be no fantasy but the real thing!

You know (getting personal for a moment) I often look in retrospect at my own career. I think how fortunate I was to have worked or associated with some of the finest - most creditable - professionals in our business. Men like Wes Hertenstein of Cal-Tech; L. Terry Suber of Colorado State; Sam Brewster of BYU; "Fife" Fiefield of New Mexico; McCree Smith of North Carolina State; Jack Hug of UCSD; Ed Dusch of Louisville; Bill Domke of Valpariso; Tom Smith of Ohio State; Harold Babcock of Oregon; Herb Collier of LSU and Houston; Jack Burnett of the University of California; Phil Koehler of Hawaii; Ted Simon of Michigan State; and George Berry of Wisconsin. By way of attendance at regional and national meetings; by letter and telephone, and by being active on association committees, I drew tremendous experiences from these people that have paid dividends through the years. Each of you has the same opportunity to draw on the experiences of your peers.

From my own experience I can say there is no problem - even the one of credibility in maintenance management - that cannot be overcome if only by seeking help from your fellow professionals. Yes, quite befitting the theme of this annual meeting - "Professionals Working Together"!

CHECK LIST

FOR

PHYSICAL PLANT ADMINISTRATORS

(1) Do you have a regularly scheduled meeting time with your boss?

(2) Do you periodically "survey" your customers to determine effectiveness of your services?

(3) Have you tried "work sampling" on your employees?

(4) Do you have solid data that backs-up your contention as to the number of manhours required for maintenance?

(5) How often do you meet with key academic and other administrative division heads?

(6) What percentage of time are you on target with your job completions and the budget for such jobs?

(7) Do you regularly visit job sites?

(8) Do you know what your "absenteeism" rate is? Do you have a program to reduce it?

(9) Do you have some methods to recognize work achievement.

(10) Are you participating on campus committees?

(11) Do you meet regularly with student representatives?

(12) Do you publish a plant newspaper? If so, do you include other campus units in your distribution?

(13) Do you keep on file current outside contract prices on custodial services?

(14) Do you submit a written monthly report of activities to your boss?

(15) Do you require periodic written operations reports from your key subordinates?

(16) When was the last time you told a subordinate how well they were doing their job?

(17) Do you furnish some sort of brochure that informs people on campus how to secure your services?

(18) Do you maintain a tracking system on work order costs?

(19) Have you personally "tested" your own trouble desk phone response?

(20) Do you keep your boss informed on your "extracurricular" activities, i.e; meetings with professional groups, outside service club work, etc.

(21) Do you stage orientation meetings for new employees over and above what your Personnel Department does?

(22) Do you have a "MOD or DIN" crew for immediate maintenance response?

(23) Do you maintain statistical data on energy consumption and costs, work load, complaints, system failures, unit cost per OGSF, deferred maintenance?

(24) Do you have regular reading habits to include professional and technical journals, management material, i.e; "Plant Engineering", "Harvard Business Review", "APPA" publications, "Business Week", etc?

(25) Do you insist on complete "staff work" by your subordinates?

Reynolds

Sluis

Buying Direct Digital Controls

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Introduction

Building automation systems (BAS) have been available for installation for over a decade now. During that time many changes have occurred with the designs of these systems. Initial products were nothing more than glorified time clocks. Computer based systems appeared in the early 70's but these were of a hard-wired nature with limited flexibility. As the microprocessor of mid-70's came into its own, the BAS as we know it today became a reality. It was during the initial implementation of microprocessor design that several fundamental decisions were made. These decisions dealt with the position of the microprocessor in relation to the data gathering locations and the central monitoring point. The economic dictates of commercialization resulted in the majority of designs with a microprocessor located at one central location and with limited intelligence in the field. As a result of this decision another fundamental choice was made by the various manufacturers about the method of communication between the field panels and the centrally located microprocessor. Since all BAS decisions would have to be made at a central location it would require high-speed data transmission to ensure that the system could react fast enough and be able to converse with a number of field locations "simultaneously". In addition, the methods of variable sensing, analog signal processing, data processing algorithms, and control functions were influenced by these early fundamental design decisions.

In the late 70's and early 80's, the use of microprocessors in many and varied applications helped to lower the price of these devices along with the price of many of the supporting peripherals that are required to make a complete system. This removed the economic shackles that constrained the designs of earlier BAS's and allowed manufacturers to bring to the marketplace distributed processing designs--where the intelligence is placed in each field panel rather than at one central location. The implications of this relocation of processing power is profound as it has an impact on all of the other fundamental design decisions of the earlier systems. Communication protocols, variable sensing, analog signal processing, etc., all had to be redesigned to take advantage of the distributed processing capability of the new systems. Finally, in taking the idea of distributed processing to the extreme, we come to the concept of Direct Digital Control (DDC). In the purist sense DDC means that all sensing, communicating, processing and controlling are done digitally. In reality the DDC systems of today combine some analog technology with digital technology, with each manufacturer combining them to varying degrees with differing methods. The end result is a

BAS industry that has little or no compatibility from manufacturer to manufacturer, or in some cases, within a given manufacturer's product line.

Iowa State University has been involved with building automation systems since 1975. The initial system was purchased as part of a new building project with the building project also supplying the funding for the installation of a centrally located computer monitoring system. This initial system consisted of a number of remotely located panels for gathering the necessary data, a locally installed minicomputer for monitoring and control, and another minicomputer for monitoring and control from a remote location. Expansion of the system was made possible through funding that was later provided as part of a total energy management program for the university. The BAS has now grown to include 55 buildings and encompasses the monitoring and control of 3,300 separate points covering distances of over two miles.

As new buildings were built, and increased utilization of the BAS in existing buildings occurred, the limitations of the system, combined with declining manufacturer support of the equipment, high energy consumption of the older computer technology, and increasing maintenance costs led Iowa State University to decide to phase-back the original BAS and begin a program of partial replacement. The question then was, "Which technology to buy?" Continue with our present vendor and his approach to implementation of DDC resulting in an integrated system of old and new? Or, "Choose a new vendor with perhaps a better DDC implementation and run two different systems side by side?" These are the same questions that are being faced by many institutions today that already own a BAS.

This paper presents Iowa State University's attempt to answer these questions. In so doing it was necessary to develop a procedure that would determine what the various manufacturer's had to offer. This was done through a series of pre-bid qualifications, product reviews, bid proposals, and bid submittal evaluation steps. The intent of this process was to limit the amount of review that would be necessary, to ensure that an "apples-to-apples" comparison would be made, and ultimately to choose a new system for future expansion of the BAS.

Pre-Bid Qualifications

In buying computer based equipment that has a great deal of flexibility, and in buying it in an environment that has fostered incompatibility, it becomes very difficult to evaluate alternatives fairly. DDC products are not generic products. Further, the qualifications of the vendor, as well as the vendor's product, is an important issue that you will need to review. Finally, it is important that you avoid specifying features that are not readily available from a number of manufacturers so that a competitive bidding environment can be maintained.

In order to address these problems we sent out a pre-bid "Request for Information" (RFI). The objective of the RFI was to identify interested vendors and to receive information on their systems. No cost information was asked for. So that the vendor would know how to respond, the RFI included a description of the campus, a description of the systems that the BAS would be interfaced with, and a description of the existing BAS. The BAS description included some equipment specifications, a listing of implemented software packages, and sample printouts of typical BAS applications in our buildings. The vendor was asked to respond in four categories: (1) hardware and hardware maintenance, (2) software and software maintenance, (3) service and (4) training programs.

Product Review

Hardware. The system hardware encompasses everything from the sensors and controlled items to the actual computers operating the process. It is important that you evaluate each item. Our method was to list each item and provide a performance statement for each vendor.

The major piece of hardware that you will be evaluating will be the actual DDC control panel. To start, determine whether the controller is a true direct digital control product. Today, DDC is an industry buzzword. There are many products on the market that began life as an electric energy controller (demand, duty cycle) and which have had a slight amount of control ability added to the product. To be a DDC product, the panel should have no fixed purpose or program. It must be completely programmable and must allow flexible interrelation of inputs and outputs. It must accept any type of input format--analog, pulsed data, or binary data. It must have sophisticated control algorithm capabilities, not just the ability to digitally turn loads on and off. You will find the most sophisticated DDC product has the least number of application limitations imposed on its use.

Evaluate the resident memory in the product. Solid state memory is inexpensive. An indication of the quality of the DDC product is the amount of memory available to implement your control methods. Is the memory solid state reusable memory such as RAM or is the controller memory a throw away method, such as PROM? Reusable RAM will serve your needs better than PROM.

Look into the processing architecture of the controller. Find out what the main processing chip for the system is. Does it meet your needs? The best products are using 16-bit microprocessors for the DDC systems or are using multiple 8-bit processors. The format may seem like a technicality, but you will find the processor format to be a key in maintaining the capability of your system.

You need to evaluate the input-output capability of the controller. Count the maximum number of inputs and the number of outputs. What are the specific types? The typical control loop will need one output for each controlled input. Evaluate the types of inputs and outputs the controller can accommodate. If the only input the controller system will accept is the manufacturer's standard sensor, you will find the system will require numerous transducers to allow you the flexibility to interface this controller to your campus. Similarly, evaluate the methods of outputting the control signal. Is there only one method or has the vendor configured numerous methods to accommodate the varying circumstances that you will encounter?

In all cases, you need to examine the accuracy of the products the vendor uses. There is very little use in having a DDC controller, capable of controlling your processes to tenths of a degree, and using sensors accurate to plus or minus 3 degrees. Find out if the vendor has alternate sensors available should their standard product not meet your accuracy needs.

You need to review the communications capability of the product. As stated earlier, this is one of the changing areas of the new technology and strong capabilities in this area are indicative of a well designed product. Any discussion of communication techniques similarly becomes a discussion of system hardware architecture. To fully grasp the architecture of the system, it is useful to make a one-line drawing of the basic structure and all the communication variations. In particular, it is necessary to identify the maximums for each technique. Will the product communicate with the other panels in your system? Will the product communicate with a host processor? Does the product require special cabling to allow this communication or will normal communications cabling suffice? Can the product interface with your telecommunications system? Will it link to any high speed data networks you have on your campus? Can the product link into your current automation system communications wiring? Can the system be installed in a remote building and be dialed up to allow communication?

In a similar vein, you need to evaluate how your personnel will communicate with the controller. Until the advent of the DDC product, most controls found in campus facilities were pneumatic. Thus, it was relatively easy to add thermometers and gages to "see" what was occurring. The DDC product changes this approach. As all inputs are digitized in the processor, a gage can no longer be added to view the operation, nor is it economical. The DDC offerings provide a wide range of parameter viewing, operating, and programming capabilities. These range from controllers with no interrogation capability whatsoever to controllers complete with RS-232 data ports integral to the controller. As this feature of the panel becomes its local window, you need to pay close attention to the features you will require to allow your building operating methods to continue.

In addition to the local operator's input and output capability, it is important to review the protection of the DDC software. To begin, if the memory of the controller is volatile (as in the case of RAM), battery support for this memory is mandatory. Additionally, some device or method is needed to support the operating program and archive the system software. The prevailing methods are data transfer to the central host computer, floppy disk drive, and cassette tape. Depending on your goals, each is an acceptable method, however they are listed in order of the authors' preference.

After the DDC product, the next most significant piece of hardware is the central processing equipment. There are a number of paths you can follow in determining the central hardware you feel you need. These paths are largely related to your operating philosophy and your desires to achieve either partial or total integration of your existing central system. The first path is complete integration of both the old and new systems. A second path would be a partial integration of the systems where either cabling or computer terminals would be shared, but with the system data bases still distinctly separate. The final approach would be a complete line of distinction between the existing campus system and the new system; in effect parallel and unrelated BAS's. Whichever path is followed there are hardware features to which you need to be aware to give your system the greatest future capability.

There are significant differences in the central processing hardware each vendor provides. The processing format and processor type are significant. The minimum capability of a central processing system is a 16-bit, formatted, multitasking system. Multitasking is a vital feature as it allows the machine to perform different tasks "simultaneously". Processor memory or memory expansion capability is as important. One of the most common system constraints is processor memory. You need to determine both the minimum increment supplied with the system and the maximum processor memory allowed.

The computer, as used in building control applications needs an external real-time clock as well as an internal circuit that allows the system to automatically restart and continue from its last known point in the event of a power interruption. Also, the processor cycle time is an indication of the execution capability of the machine. The lower the number, the better.

In systems used for campus monitoring applications, a disk memory based operating system is a necessity. You need to closely look at the capabilities of the disk system and its relation to the operation of the system. As disk memory is bulk data storage, the available memory is a key. You need to know how much of this storage the system can actually access. A 400Mb disk drive is great, but if the operating software of the system can only use 50Mb of this storage, you really haven't gained a great deal. Another significant aspect of the disk storage is the access time for each transaction. Your system will be constrained by some aspect of the hardware at sometime. It is very likely that it will be access time to the disk storage that makes the system seem unacceptably "slow".

Another feature which will be important is the ability to add mass storage in the future. Systems that cannot have mass storage added may require a complete processing system change in order to allow your system to grow.

Software. There are two levels of concern in obtaining software for the new system. The first is to ensure that the same algorithms that are implemented on the existing system can be duplicated with the new software so that control strategies that are working well with the old hardware can be implemented on the new hardware. The second is to determine what improvements have been made in personnel interfacing, software maintenance, systems analysis and communications protocol. As in hardware, you will need to scrutinize the software you will be receiving with this system. In most first generation campus automation systems, software was only a consideration for the central processing equipment. This is not the case with the DDC product. In the modern DDC, software is required in both the field panels and the central processing equipment. Each needs to be carefully evaluated. Software found in the central processing system is much akin to first generation systems, although numerous new features have been added. The more important software that needs to be analyzed is the DDC software. The second generation purchaser of such a system is well equipped to review the applicability of these packages.

There are a few new twists which were not found in previous offerings. Consistent with the entire EDP industry, some DDC vendors no longer sell their software. Instead they make you a licensee and this becomes a significant consideration in examining the software. Some offer perpetual licenses while others have an annual cost associated with a yearly renewable license.

Another area of concern is the development of vendor independent software. In prior generation systems, the system vendor had a "hold" on the user when it came to system software changes. The newer software systems have a fully flexible, easily understood and changeable system software. It becomes a mandatory requirement to have such complete vendor independence in a campus DDC automation system.

There are two major DDC areas you must analyze. The first is the language the DDC software is written in and which you and your people must use. The second is the actual control capability of the language. There are as many approaches to DDC programming languages as there are DDC products. These vary from number based systems written entirely in code, ladder type diagrams, coded languages, and programming languages that closely approximate language in everyday use for non-automation applications. Take the time to study each one. Write a simple application yourself and ask each vendor to supply a program listing completely commented with line-by-line explanations. Provide the listings to the people that would regularly be involved with their use. The more easily understood the system, the more likely it is that it will receive rapid acceptance. Your maintenance personnel, who typically are only familiar with pneumatic controls, will have to become as familiar with the BAS as the personnel that are specifically assigned to operate the BAS system. The software should be listable to allow analysis, preferably at both the central processing and DDC panel locations.

Your second concern is, "How good a controller is the product?" DDC will replace your traditional approach to control system products. As stated earlier, you certainly need a product that is capable of doing the applications you have today. The advantage you have in the DDC product is that it can also do the applications you will have tomorrow. You need to check all the available features and algorithms to find the maximum flexibility. Can the controller do on-off control? Proportional control? Integral control? Derivative control? Adaptive cycles? Does the controller have the capacity for sophisticated logic? Can you write your own cycles? Can the controller integrate variables mathematically? Does the controller have sophisticated subroutines such as enthalpy loops already established, or do you need to write these common routines yourself? You will find a great deal of disparity between manufacturers. Remember, the job of evaluating the product is not only to find out what the product will do, the job is to find out what the product WON'T do.

Service. The second generation purchaser will already have a good feel for the importance of system service. But service goes beyond the technician in the white smock. The vendors capabilities and commitment to you must be thorough. The purchase of a second generation system in many ways parallels the original purchase of a system. There was a time when hundreds of vendors made some form of computerized automation product. There are now numerous suppliers of DDC products. It should be evident that just because a vendor elected to manufacture a DDC product it does not qualify him to be your supplier.

To begin, examine the company. Is the company committed to HVAC and building control? Do they understand the needs of buildings? There seem to be two forms of organizations present in the DDC field, computer manufacturing firms and building control manufacturing firms. It is our view that the most successful firms in the field are those firms with the best building control understanding. Does the company have a local organization of both technicians and control experts that can give you expedient answers? Is this organization familiar with the product they propose you buy? Is there another layer of field service available to you when the local organization cannot deal with your problems? Are you comfortable with the manner in which they seek your business? Companies always have their best foot forward during the sale effort. If you feel uncomfortable at this time, be certain you will be unhappy later. What is their local and national service policy? Is this policy defined? What is the company's local and national inventory policy? Is there a stocking location nearby or do they build each order as the order is placed?

Many companies are happy to supply a list of customers that have ordered systems similar to the one you are contemplating. You need to talk frankly with these and other customers of the company in question. Be aware however that often it is difficult to get a frank assessment from someone whose purchase is not yet operating. Likewise it is difficult to have someone state that the purchase decision they made was a mistake. Don't assume that another purchaser has done your homework for you and place the assessments of other purchasers into their proper perspective. When you do spend the time to talk with other users, do it with a plan. Before you have your conversation, make a list of questions. Make sure your list includes service related questions and questions about policies of the company during product line changes or system upgrades. Some companies completely change their technology when it is necessary to redesign their systems. Others support only certain features in certain hardware configurations and mandate the wholesale change out of all equipment to allow an expansion.

An important service related question is "Does the vendor understand HVAC and building related questions?" If the vendor does not, do not buy their product. The ultimate service of the vendor is the final product working as intended. If they do not understand the function required, you will never see the end product.

Another question of service pertains to the product itself. Vendors design products all too often to suit sales needs and not serviceability needs. You need to look at the product from a service point of view. Is the product easily serviced? Are sufficient servicing manuals available from the vendor? Does the vendor have a policy of retaining service information only for their own use? Is the product manufactured solely by the vendor or is this product a composite of numerous manufacturers? In the event that the system is a composite, what is the arrangement your vendor has made to have the other manufacturers equipment serviced? You can be easily left "holding the bag" if a system you purchase is a composite and many of the component manufacturers no longer offer service. In a similar vein, does the vendor mandate a service contract on the equipment to guarantee service? While this approach may suit your needs, many large users now have the sophistication to handle the servicing of the entire system. Conversely, will the vendor supply a service contract on all or parts of the system? There is no better way for finding an organization without a definite service approach than to have a company tell you they have no service contract policy.

Training. You cannot evaluate training capabilities without first establishing the operating philosophy under which you will be using the system. Training is only important to users that take an active role in the support of their systems. Most large system users elect to service the majority, if not all of the system. When you have decided on your approach, you need to view the training offerings of the vendor. The quality and the extensiveness of the training program is often an indication of the vendors dedication to the BAS industry in general and his systems in particular. Will the vendor provide on-site training? Will the vendor provide complete manuals and a commitment to keep the manuals up to date? Will the vendor provide in depth training on both the engineering and servicing of the system? Do national level training courses exist? Are these courses comprehensive or superficial? Is the vendor willing to have your personnel work along side the system vendor technicians as the system start-up occurs? Does the vendor offer training on non-DDC related subjects, such as HVAC and building operation? Has the vendor trained his own people?

It is rare that the cost of training, in the purchase of systems such as these, exceeds 1% of the total purchase price. However, it is that 1% that enables your people to fully utilize the system you have purchased. You need to keep in mind that a system such as a DDC system will create apprehension in the people that have been servicing your building system controls. They will be inclined to fear the unknown. The issue of training is your vehicle in alleviating this apprehension and in getting this group productive in a changed environment. Take extra care to select a vendor that can provide this high level of support.

Bid Proposal

The bid proposal parallels your review of the technical merits of the system and the vendor. Your purpose is to develop a document that will allow the purchase of the system that best meets your needs, today and in the future. You have already eliminated the systems that do not have sufficient technical merit to be considered through the RFI review.

It was our view that the specification not only needed to address the present performance aspects of the system, but also to provide protection of our future interests. As this purchase would "lock" us in to a given manufacturer for the duration, we saw a need to stipulate the terms of future purchases. However, we did not want to prevent other automatic temperature control (ATC) vendors from bidding on new installations. Therefore, we developed a policy of purchasing the DDC panels ourselves and supplying them to the project with installation by the project ATC vendor. Start-up and testing is done by our own people with support from the project ATC vendor for installation corrections and from the DDC supplier for DDC hardware and software corrections.

Thus, the purpose of the bid proposal was to obtain system pricing information for both present and future purchases. The proposal took the form of a specification document that also identified our future system needs. Before this was done however, an institution wide philosophy was established that governed expansion plans. Without it, future BAS installations would have been a hodge-podge of unrelated equipment.

The specification should parallel the form of the technical evaluation. If you followed a tabular format for this evaluation the features that you need to include in your specification will be readily apparent. You need to compile a list of absolutes that your system must have, a list of the features the system should have but you could live without, and identify those features that you have no desire to have. Your specification should include the absolutes and the nice-to-haves, and not include references to the items you can live without.

The issue of the specification inevitably must address the nature of its wording. The various manufacturers would certainly like you to use the wording from their specifications and will certainly offer this to you. Beware of this approach. As stated earlier, your intention should be to obtain a competitive bid. Reuse of a manufacturer's specifications may limit the competitive position of the other suppliers. Our approach was to develop a performance and feature based specification that encompassed the needs of our university and avoided the typical automation system gloss that so often is found in these specifications. As our product review phase had narrowed the group of acceptable bidders and products, it was not necessary to write a specification that included every detail of every system. We stated in the specification the names of the acceptable systems the vendors had proposed and this allowed those features that were common to all to not be included. Our specification included a section on each of the areas we had reviewed in the product review--hardware, software, service and training. Additionally, we were making a purchase for two specific new projects, so our purchase included performance requirements for these two projects. This took the form of operation descriptions and point connection lists for each building.

The final aspect of our proposal concerned the need for identification of future costs and alternate configurations. To quantify future costs, we asked each vendor to supply a pricing structure for the next ten years. We stipulated that they provide a nationally published price list and discounts available for purchasing during this time frame. We did not stipulate a maximum allowable percent increase from year to year as we felt it would be a difficult matter to enforce.

We wrestled with the issue of whether we would have a completely integrated system of old and new, or two separate systems. One of the proposed systems had a number of attractive features, but could not be integrated into our existing system while another allowed complete integration of old and new. Our approach was to require all bidders to bid a non-integrated system. We made the integration of the systems a bid alternate.

Submittal Evaluation

The submittal evaluation is a process for determining the system which best suits your needs. It includes both the costs of present purchases and the costs of future purchases and services. It also allows a weighting for the quality of service the vendor provides and other intangible issues.

You need to tailor your evaluation process to reflect the philosophy you have established for your campus. Will you go with only one company or will you have numerous suppliers of incompatible systems? Will you have one centralized operation or scattered decentralized operations? Is the product you feel best suits your needs the most technically up-to-date, or can you do without certain features? The fundamental questions concerning your system expansion as well as the evaluation method you will be using need to be established before receipt and opening of priced proposals in order to allow an uncolored evaluation.

To proceed with this evaluation you need to establish both your current needs and your future needs. Your current needs are evident. Your future needs are not. We felt the best way to project our future needs was to determine the anticipated changes to the campus in the upcoming years by using the historical point density in existing buildings. It was our view that on the average, classroom and office buildings would use 2 points per thousand square feet, and laboratory buildings 3 points per thousand square feet. We looked at ratios of the types of points that would be needed and found that in 100 typical building points, 45 would be analog inputs, 25 would be binary inputs, 18 would be analog outputs, and 12 would be binary outputs. Using the future plans for renovations and additions to our campus we were able to extrapolate the number of future point types as well as the number of control panels that would be required.

The data for the future expansion of the system, as well as our current need, was consolidated into a microcomputer spread sheet application to allow rapid analysis of the various proposers' pricing data. This allowed the determination of the actual cost of the system in today's dollars. The actual evaluation was more than a summary of pricing. The evaluation included such intangibles as our service experience with the company, reputation, and distance from our facility. Each of these was assigned a numeric weighting factor. Service was deemed to be 20 percent of the value of the overall evaluation, with reputation being worth 5 percent. Pricing was determined to be 25 percent of the evaluation. Each of the proposers were assigned the service and reputation factors based on our previous experience. These factors were assigned prior to the receipt of bids so as not to be swayed by the pricing data. As the original technical review had eliminated the systems we felt were not appropriate for use in our facilities, there was no need to make the evaluation portion of the process a lengthy process giving points to various features of systems. The prospective systems were as much an "apples-to-apples" comparison as possible.

Conclusion

The process of a RFI, bid proposal and bid evaluation was a lengthy one. In all it took approximately nine months from the start of the investigation to award of a contract. During the process, we learned a great deal about the vendors in our area and the products they had to offer. We were forced to think through our future needs and to develop an operating philosophy that would be compatible with the university's operation and the existing BAS. The vendors were satisfied that we had given them a "fair shake" and we are satisfied that we have made a knowledgeable purchase.

Planning a Preventive Maintenance Program

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Introduction

Planning should be the first major phase of a preventive maintenance program. The amount of effort and forethought that is put into this phase will be reflected throughout program development and ultimately in the operation of the program.

Definite ideas on selling the program, forms design, equipment inventory decisions, staffing, equipment needs, inspection standards and on through to eventual reporting are but a few of the many considerations required.

A well planned program can produce substantial repair cost avoidance results even before the program is operational. By operational I mean a program that is producing PM work orders at prescribed frequencies and is also producing meaningful reports.

Planning however, needs to go beyond the traditional reasons for establishing a PM program and include considerable thought in energy conservation.

During the recent energy management conscience years, an effective PM program is regarded as an absolute necessity for the successful operation of an efficient energy management program. Equipment that is not operating at peak efficiency will result in wasted energy, unnecessary operating expenses and an energy management program that never lives up to its fullest potential.

Setting Goals

PM, like most other worthwhile projects must have certain goals and objectives that need to be established at the beginning of the project. Without some sort of direction or focal points and time table, the best of intentions tend to go astray.

A simple way to make sure that objectives are achieved and within a reasonable time frame is to make a "schedule of major events" form (an example of which is exhibit #1). The first two goals or events on the schedule pertain to selling the program. Thereafter the events should be in sequence somewhat in the logical progression of planned development.

While this is not a hard and fast rule it helps portray to others the steps that are required to complete the program.

Since this schedule or copies of it should be included in various progress reports to management it is advisable to indicate the status of each event by circling the appropriate "x". As you can see the reader will have a complete overview of progress at a glance.

Yes, even the planning process should be a scheduled event. And if you suffer from interruptions and distractions throughout the day, as many of us do, there will be events that will be forgotten or missed. Therefore, leave a space or two between events for additions and be prepared to be flexible.

What may have sounded like a good idea today and perhaps even a high priority item may seem less important tomorrow. Investigating the feasibility of each event and how it interacts with the whole program should be continually questioned.

Selling The Program

Selling management on the installation of a preventive maintenance program can be compared with an insurance salesman selling insurance. In reality the maintenance department is endeavoring to sell management "equipment performance insurance". Since management by nature and training is accustomed to dealing in tangibles - the maintenance manager should have enough facts and figures to convince management that preventive maintenance is not an intangible, but a program that will definitely reduce failures and maintenance costs.

The approach I took and one that worked quite well required some research into past records and monitoring current daily activity. If you have a work order system of some type either manual or computerized, the research becomes easy. Somewhere in the records are the facts, figures and costs of equipment failures that need to be included in the "selling package".

During the research and monitoring of daily activity, I selected failures that I felt were caused by the absence of an effective PM program. Burned out motors, belt replacements, door locks, door closures, panic hardware problems, PRV stations leaking, burned out bearings and stuck elevators were just a few problems that were included in the research.

The work order numbers of the selected failures were entered into our computerized work order system which produced labor and material cost listings. The summarized data from the listings, coupled with past documented failures were added to the selling package.

The costs associated with starting a PM program will certainly include labor, equipment and possibly some type of inexpensive transportation. If you plan to start out on a small scale as we did, the costs can be minimal.

So, to wrap up the "selling package", you should be able to demonstrate the costs of past and on going failures, projected costs without an effective PM program and start-up costs. I spent approximately three months developing the selling package of which most of the time was devoted to accumulating and summarizing the collected data.

Forms Development

The equipment inventory form will be the first and probably the most important form in the program. You may want to consider designing your own inventory form or use one that is already designed. The form should include at minimum, space for equipment identification and location and name plate data. If you plan to computerize your program be sure the design will conform to data entry standards.

With a little extra planning, if you choose to design your own form it can be used for more than gathering the basic equipment information. For example on exhibit #2, electric motor form, I wanted to see not only the unit being inventoried but also the driven unit and the primary system involved.

This same form is used for inventorying almost all the equipment to be included in our PM program. Only the form title and the bottom half of the form is changed to accommodate specific name plate or other data.

After an inventory data base is created, the stored data can be manipulated and sorted to obtain information in various listings for example, exhibit #3 is a sample list of motors within a building by motor i.d., horse power, manufacturer, location, and driven unit i.d.

Other listings may include motors of certain horse power ratings within a building or for that matter the entire campus. Such listings might be used in energy management studies, determining future capital investment requirements or for compiling a composite inventory of all motors on campus. The information available and the use for it from the data base file is limited only to an individual's imagination. The information in the file will most certainly be used in creating PM work orders.

Staffing The PM Shop

There can be no question that the success or failure of the PM program will, to a large extent, depend upon the staff.

The staffing level will depend upon first of all, management's commitment and budget constraints. A program can, from past experience, be started with one person. There are a number of limitations but it can be done.

Data gathered from other resources indicates that initial staffing of a PM crew should be ten to fifteen percent of the regular maintenance crew. Age and size of a complex or facilities and the extent of the inspection program will ultimately determine the staffing level.

The PM crew must be staffed with people whose abilities and knowledge are considerably above the average maintenance repairman. You must remember that these people while usually not specialist in any particular trade must be able to perform intelligent inspections, make minor repairs and adjustments and be able to recognize problems that require the attention of specialists of any trade. Additionally, the people that are assigned PM responsibilities should be separated from the maintenance operations and placed in a PM group and report directly to a PM manager. Personnel in the PM group while responsible for some repairs must be more equipment service and inspection oriented. Repairs should be limited to a half hour or less.

By adopting the separation and minor work only philosophy, the program will take on a certain importance and not be subjugated to large repairs, renovation or long term planned maintenance programs. A well run PM crew should be kept on the move performing inspections, equipment service and reporting potential problems for repair in order to avoid total equipment failure.

Plans For Starting The Equipment Inventory

The equipment inventory, without question is probably the single most difficult and time consuming part of establishing a PM program. It follows then that extraordinary care should be taken when developing plans for the inventory process so that it can be completed in the most efficient manner possible.

Where to begin and what equipment to include in the inventory are usually the first two questions that are asked. Research and past experience indicates that first of all a pilot area should be selected as a starting point. A pilot area may consist of one or two facilities. Machinery that is considered as critical operating equipment such as motors, pumps, fans and perhaps electrical gear should be included in the initial inventory.

If you do plan to start your inventory in a pilot area the decision on exactly where to start can be found by answering one question. In which building or group of buildings can you least afford to have equipment failures and problems? In our particular setting at C.U., the answer was our primary research complex. It was within this complex that an unexpected loss of a motor, pump, fan or an electrical system for more than just a few hours could seriously jeopardize years of research as will as risk the health of the building occupants. Strict temperature controls for various laboratories and frequent changing of building air is of the utmost importance.

The Equipment Inventory

I consider the equipment inventory process to be the one most important part of the PM program not only because the information gathered is vital to the entire program but also because this is what I have found to be the opportune time to perform specific additional tasks. If properly planned the entire inventory process can be extremely useful even before the PM program is fully developed and operational.

Since the inventory process is one that usually requires a mechanic to spend a considerable amount of time in a mechanical room or area you may want to consider incorporating in your inventory plans three additional tasks, they are: (1) survey the equipment, (2) visually inspect the area and report all apparent adverse conditions, (3) test and monitor bearings on all rotating equipment to be included in the PM program.

Surveying The Equipment

A mechanic using a survey form (exhibit #4), makes a rough sketch of the mechanical room or area and the approximate location of the equipment therein.

Symbols are used to designate specific units or "classes" of equipment. Various rooms surrounding the mechanical area or stairwell leading to the area are included on the survey for the purpose of "landmarking". This makes future locating much easier especially for the new mechanic and even quite often for the veteran. Copies of the survey are often attached to repair work orders.

Warnings are also stated on the survey such as "possible contamination hazards", as in fan rooms that serve chemical research areas. Other warnings will also include equipment that is under "off - on" control of our energy management computer.

During the initial inventory it is important that all mechanical rooms and areas are located. It is equally important that a mechanic does not have to spend a lot of time searching throughout buildings looking for equipment areas. In order to avoid a considerable amount of mechanical room search time, I provided our mechanics with building blueprint floor plans. The time saved in locating equipment rooms, plus other uses for the plans has more than paid for the in-house blueprint copying.

With the rough survey forms completed, the mechanics can assign and paint equipment identification numbers on the units. Each specific class of equipment is assigned numbers in ascending sequence (01) - (n), starting in the lower most level, up to the roof of a building. If some of the equipment has been reasonably numbered, for some prior purpose, we use those numbers and when necessary assign new numbers around the old. To ensure accuracy and eliminate the possibility of duplicate numbers within a specific class within a building, a list of each equipment class is made showing all assigned as well as unassigned numbers. (exhibit #5).

When the inventory is completed in an area or mechanical room, the rough sketch of the survey forms are returned to the office where they are neatly redrawn, typed and filed with the completed class lists. Completed inventory forms are also typed and filed in preparation for data entry.

Visual Inspections

While the mechanics are surveying and inventorying a mechanical room or area, they have been instructed to report any adverse conditions they may find such as water leaks, broken locks, dirty filters, missing belt shrouds, steam leaks, debris laying about on floors, or any other conditions that may require attention. Quite often these problems are missed or ignored by tradesmen who are in and out of an area for the purpose of repair only and concerned with completing their assignment and moving on to the next.

Bearing Testing

Testing and examining all bearings should be an integral part of the inventory process. We recognized early on in the program planning that next to unexpected power outages sudden bearing failures were one of our major mechanical failure problems.

Bearing failures over an extended period of time and in a controlled and predictive program can be considered a part of normal operating costs. However the undetected damage caused by bad bearings such as scored and possibly severed shafts becomes extremely costly and disruptive to maintenance budgets. Since we have included bearing testing in our inventory process and now into a formal quarterly inspection program, bearing problems have been virtually eliminated.

All bearings on equipment to be included in the PM program are set up on frequency checks, depending upon initial readings. Bearings that produce normal readings are checked quarterly while others depending upon readings or service are checked weekly or monthly.

A special graph form (exhibit #6), is filled out for each unit of equipment to be checked and subsequently monitored. As readings are taken the results are recorded on the forms by date. Over a period of time the graphs illustrate normal and adverse trends of the bearing life. When adverse trends become apparent the bearings are replaced thus avoiding any additional damage. As bearings are replaced records of the replacements are kept on file for future reference.

One of the many advantages of combining additional tasks with the inventory process was realized the first time we used our bearing testing equipment. Readings taken on a 3" fan bearing showed that the bearing was in a failure mode. Subsequent inspection of the faulty bearing reveled an advance case of spalling on the inside of the outer race. Since the fan was down, both inboard and outboard bearings were replaced at a labor and material cost of $373.00. Had the defect gone undetected, failure costs according to factory replacement information, would have ranged from three to ten thousand dollars. The instrument we purchased for testing bearings paid for itself immediately.

By adding the three extra tasks to the inventory process I think you will find as we did that the advantages will far out weigh the extra time and expense.

Inspection Standards

Inspection standards are developed basically for one reason - to provide adequate instructions that when carried out will extend the operational life of a unit of equipment. These instructions when stored in a computer file can be printed on PM work orders at scheduled inspections frequencies.

The standards need to be short to the point and identifiable. Each standard needs a computer recognizable identity mainly for the purposes of additions, changes, deletions and future reporting.

When preparing a set of inspection standards for a unit of equipment, say a major air handling unit, you will find that one or more trades may be involved in the inspections at specific frequencies during the annual inspection cycle. For example, HVAC inspectors will check hot and cold decks, freeze stats, dampers and so forth semi-annually. Electricians on the other hand may inspect the driving motor while machinists may inspect belts and belt shrouds at still another frequency. Oilers, greasers, filter changers and vibration specialists during still other frequencies.

How much time is going to be required to perform these inspections is still another consideration. To begin with, an estimate of time is required for each standard or group of standards. The estimates will be used to calculate approximate man-power requirements, establish a tentative annual inspection schedule and generally provide a base that can be refined in order to arrive at reasonable inspection time standards.

Keep in mind that when you think you have a set of inspection standards completed the people that will be using them should have the opportunity to review them.

A minute ago I mentioned that the standards can be used to develop manpower requirements. Exhibit #7 is a set of standards I have developed for a major fan system. By doing some simple arithmetic and counting the number of fan systems from the survey forms or class lists mentioned earlier, projected annual PM inspection hours per unit of equipment can be made. I think you will find the results surprising. Incidently, if you will note the inspection standards portion of the form is ready for data entry.

PM Master Schedule

The development of an annual PM master schedule is another important factor that should be included in the overall planning process. The information needed to produce the master schedule will come from the inventory data base and the inspection standards file.

How the schedule is formatted or the information portrayed is a matter of choice. All that is required is a simple summary print out showing the approximate required PM man hours per class of equipment and frequency by building and by shop.

The master schedule will be a simple but valuable tool that can be used to plan vacation schedules, future work loads, adjustment of frequencies and avoid "bottle neck" scheduling problems.

The annual master schedule is not intended to be the actual scheduling device but rather a tool that will provide schedulers, foreman and others with a broad overview of what must be considered in detailed scheduling for the year.

Actual PM Scheduling

Daily, weekly or monthly scheduling will no doubt be one of the more involved procedures in the PM program. Calculating net available PM man hours presents no real problem. The real challenge becomes evident when the net available FTE hours are substantially lower than the projected hours required for PM inspections.

Increasing FTE levels is one solution to the problem however, it is one that is not always feasible or often not practical. With some forethought and planning there are some options available that will help bring net available hours and required PM hours within working limits.

First of all you will need to determine where in a complete PM cycle the high and low net available hours usually fall. A research of two or three years of vacations, holidays, sick leave and other non-productive time should provide the basic and averaged information needed.

You will undoubtedly find that vacations account for the most non-productive time during the summer months. Therefore it may be necessary to establish or revise existing vacation policies that will shave the annual vacation peaks in order to help align net available hours with required PM hours. It may also be necessary to establish policies regarding other types of non-productive time.

A well planned PM inspection routing scheme is another option that will help increase productive time. The routing scheme should be designed so that when work orders are issued they are in a sequence that will lessen a mechanics travel time from building to building and within a building. Here again we have a valuable use for the building blueprint floor plans and the mechanical room surveys.

Reducing inspection frequencies on some equipment is another option that will help to bring available and required hours closer together. Needless to say this action requires careful consideration.

Eliminating inspections on some equipment is one of the less favorable options, however it should not be totally disregarded. Again, careful consideration is required.

A decision is also required as to how much repair work an inspector makes during his rounds. If plans are made to limit repairs to just a few minutes or non-at all, the number of inspections will increase proportionately. If no repairs are made it means issuing a repair work order for the regular maintenance crew. This may be a trade off situation that requires some thought.

The main objective is to use available man hours to the maximum in order to come as close as possible to required PM hours. If a computerized program is properly programmed the computer will be of great assistance in maintaining schedules. Ultimately however, the shop foreman or planner scheduler will be responsible for controlling the fine details of scheduling PM work orders.

Equipment Shutdowns

Planning equipment shutdowns is still another major consideration when developing an effective PM program. The purpose of a shutdown is to be able to perform in-depth inspections and cleaning on certain types of equipment that cannot otherwise safely or effectively be accomplished when in operation.

Although a scheduled shutdown is a part of a PM program and would usually be initiated by the PM office it is more accurately described as a planned maintenance function. Therefore the actual work involved would normally be completed by the regular maintenance crew.

Specific plans and procedures for any type of a shutdown needs to be established and well documented during this phase of program development. Several people will need to be involved during the planning process so that a state of complete preparedness is in place when a shutdown work order is issued. The PM manager, shop supervisor, foreman and energy management officer are a few of the people that will most often participate in planning shutdowns.

A shutdown request (exhibit #8), should be filled out appropriately signed and distributed by the PM office at a reasonable time prior to a shutdown. Some of the basic information on the request are location of shutdown, floors or areas of a building affected by the shutdown, length of time down, start and stop time and reason for the shutdown.

When planning shutdowns, be sure to include a check-off list that will detail the equipment and tools required as well as the procedures involved. Exhibit #9 for example, is a check-off list for cleaning and balancing major fan systems.

In order to avoid delays and expedite a shutdown it is advisable to move equipment, tools and materials to the job site the day prior to the scheduled shutdown.

If properly planned and carried out, a shutdown will not only extend the life of your operating equipment but will also in many cases improve its performance and avoid costly failures.

The PM Work Order

The primary functions of the work order is to provide work authorization, directions to the worksite - building name, equipment i.d. and location, inspection instructions, and serve as the basic PM system input document. The work order (exhibit #10) should be designed to permit efficient data entry and provide adequate space for manual entries and comments by the mechanics.

Other information you may wish to include in your work order design is frequency (week number), due date, last inspection date and next inspection date. This information will give the mechanic the opportunity to adjust original inspection frequencies more precisely, based upon his findings during routine inspections. If a mechanic feels an inspection frequency is too close, or for that matter too far apart, he has the option to change the next inspection date. When the completed work order is returned for data entry, the new inspection date is entered into the system. Future work orders for that unit of equipment will then be issued based upon the date change. This type of flexibility provides the opportunity to keep "close tabs" on suspect equipment. On the other hand after an initial inspection or two, it may be quite possible that adjusted frequencies could help balance available man hours with required PM man hours.

As a mechanic completes an inspection standard or group of standards, the actual time will be recorded in the space provided. The recorded actual time will be compared with estimated time for the purpose of establishing reasonable inspection time standards.

Established time standards will help improve scheduling, determine more precisely FTE requirements and provide a base from which various analysis can be made on reported time.

Follow-Up On Completed Work Orders

This is a necessary requirement in any work order system. By mutual agreement the PM manager and shop foreman select completed work orders and visit the site where the work was performed. The purpose of the visit is to look for evidence that the work was completed as prescribed by the work order.

This is also the opportunity to analyze actual time reported with estimated inspection time. If actual time is substantially different from estimated, it may mean that a mechanic has found a better way to perform the work or is, for some reason, using more time than necessary. Adjustments in schedules, estimates or other remedial action may be necessary.

Report Design

This is a vital phase of the program that often should begin almost simultaneously with the start of the program. Knowing what information is needed for making decisions, equipment evaluation and personnel performance, tracking costs, equipment history, adjusting schedules and generally "keeping a finger on the pulse" of the program are but a few of the items that will have a direct influence on the input and total system and report design.

Detail type reports are usually used by the man on the firing line (foreman or supervisors) where corrective action can start as soon as results are known and begin to fall short of the established norms.

Control information in the form of summary reports will be more effectively used by middle and upper management.

For this presentation I have selected what I believe will be three of the major reports in our PM system. All three pertain to labor and equipment costs and equipment history. Other reports from the system may pertain to the inventory, master schedule, equipment by class listings, issued work orders, craft backlog and other necessary detail.

The first sample report, Equipment Summary by Unit (exhibit #11), displays various data of three electrical motors. The important features of this report are "other costs" and "equipment value." "Other costs" are a result of repairs made between PM cycles or are a result of PM inspections. Ideally, other costs should diminish proportionately with PM inspections and service. If they do not then an equipment and perhaps personnel performance evaluations are in order.

Costs that are approaching or have exceeded "Equipment Value" in an unreasonable amount of time is another indicator that an investigation or evaluation may be necessary.

When planning an investigation consider equipment age, use, environment, repair workmanship and PM frequency. Over a period of years it is not unreasonable to assume that PM and repair costs will eventually exceed in some instances, equipment value.

When equipment evaluations become necessary, the Equipment PM/Repair Detail Report (exhibit #12), will show in detail the various charges and a description of the work completed on a unit of equipment. It is only necessary to run this report or display on a CRT when the detail information is actually needed for a unit of equipment.

The third report, Building Summary (exhibit #13), is a summary of equipment cost by building. Information on this report coupled with other building costs, such as custodial expenses can be used to determine facility maintenance costs in total or by square foot.

When planning various report designs, content, and printing frequency consider first, if you plan to computerize, the use of the computers' CRT terminals. They are excellent tools for retrieving data quickly and efficiently. Printing a report, for example just to check the repair history of a unit of equipment for the past six months is in most cases a waste of time.

I think you will find that where there is a proliferation of reports sooner or later they all become meaningless because no one has the time to sift through them for what may be needed.

They key to a successful reporting structure is to keep in mind that reports should be simple to read and understand, limited in number and provide the information necessary to control the program and present data for analysis.

Program Documentation

Documentation of a PM program should be part of the initial planning phase and continue throughout program development.

The purpose of the documentation is to establish certain policies and procedures for each part of the program. It is also within the policies and procedures, the opportune time to delineate the responsibilities of all personnel that will be involved in the program.

If you plan to computerize your PM program the documentation should clearly define to the programmer or systems analyst what you expect the program to do.

The documentation that I have prepared is more in the form of a manual complete with index, overview statements, program objectives, policies and procedures and sample forms, and reports. Exhibit #14 is one section of the policies and procedures.

The success factor of the PM program will be increased proportionately with the amount of information available to those involved in the project.

Energy Conservation and Support

There is no question that a well planned and fully developed PM program will in many ways help reduce energy costs. This will happen almost automatically even without much thought put in to Energy Management during program design. With some thought however, during the planning stages, substantial results can be achieved during program development and on into program operation.

At some point in the inventory process it will be necessary to inventory steam systems. Plans for inventorying the steam systems should include steam trap evaluation. (Research indicates that where there is no specific steam trap maintenance program, the average number of bad traps can be 40 per cent of total. Further research also indicates that a steam trap having for example, a half inch orifice and is not working properly can cost as much as $50,000 annually in wasted energy). It is essential therefore that plans are made to not only inventory the traps but also to make repairs and/or replacements as necessary.

Additional PM program plans that should be directly geared to Energy Conservation as well as support for an existing energy management program, includes fan cleaning and fan balancing.

Fan cleaning includes purging bearings, inspecting slinger rings on sleeve bearings, checking and adjusting sheave alignments, cleaning fan blades, inspecting intake louver operation, inspecting filter media, and cleaning and inspecting fan coils where applicable.

Balancing a fan wheel especially on large systems require the use and operation of a vibration analyzer and a trained employee who can operate and interpret the results of the instrument. A cleaned and balanced fan wheel will improve power transfer from motor to fan wheel, reduce stress on bearings, piping, foundation and other fan components.

Cleaning fan coils, where applicable will decrease static pressure, improve heat transfer and generally reduce the energy required to move a volume of air through the coils.

Proper maintenance and inspections on fans, fan coils, and steam traps are only two examples that if properly planned, will help conserve energy and insure the success of a Energy Management Program.

Those of us who are responsible for planning must consider all other aspects of plant maintenance and incorporate those plans into an effective program.

Equipment

Throughout the initial inventory process and on into a developed program, the use of special instruments are, I have found to be an absolute necessity. In many cases especially during the inventory there exists the opportunity to bring equipment up to maintainable standards as well as detect equipment in the failure mode.

I would encourage anyone currently involved in a PM program or if you are just starting a PM program to investigate at least bearing testing and vibration analyzing instruments. The return on investment can be surprising. I will be happy to discuss our results with the equipment after this meeting.

Conclusion

The evidence of an effective Preventive Maintenance program at the University of Colorado, even in its early stages have been to say the least, outstanding. In a program such as this there are any number of tangible and intangible results most of which can be measured in some way or another.

One of the most interesting intangibles I have found was, employee interest. At first the attitude was, well here is another attempt at PM. Now that the commitment to PM has been so vigorously demonstrated and supported by top management the interest and suppport is 180 degrees from what it originally was.

Thank you for your interest and attention and if I can be of any assistance to anyone please do not hesitate to contact me.

UNIVERSITY OF COLORADO
FACILITIES MANAGEMENT

PREVENTIVE MAINTENANCE — SCHEDULE OF MAJOR EVENTS

MAJOR EVENTS	1982 OCT.	NOV.	DEC.	1983 JAN.	FEB.	MAR	APR	MAY	JUN	JUL.	AUG	SEP	OCT	NOV	DEC
Research and Collect Data for Selling Pkg.	X X X	X X X	X X												
Summarize/Present Pkg.				X X											
Plan the Program					X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X	
Forms Development					X X X	X X X	X X X	X X							
Staffing Advertise - Hire							X X X	X X X	X Ⓧ X	X X					
Plan Equipment Inventory					X X X	X X X	X X	X X X	X X Ⓧ X	X X	X X				
Inventory Equipment									X Ⓧ X	X X X	X X	X X X	X X X	X X X	X X
Prepare Inspection Standards						X X X	X X	X Ⓧ X	X X X	X X X	X X X	X X X	X X X	X X X	X X
Prepare Master Schedule														X X X	X X
Plan Equipment Shutdowns												X X	X X X	X X X	X X
Design Reports	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X Ⓧ	X X X	X X X	X X X	X X X	X X	X X X	X X
Document Program					X X X	X X X	X X X	Ⓧ X X	X X X	X X X	X X X	X X X	X X	X X X	X X
Design PM Work Order															X X

EXHIBIT # 1

EXHIBIT # 2

EQUIPMENT INVENTORY

PREVENTIVE MAINTENANCE FACILITIES MANAGEMENT

****

ELECTRIC MOTORS

****

INVENTORY DATE: ____/____/____ TRADE: ________

UNIT DESC. I.D. NUMBER		PRIMARY UNIT DESCRIPTION	BLDG.	BLDG.	FLOOR	ROOM
UNIT I	UNIT II		I.D.	NO.	NO.	NO.
MTR02	SF01	Supply Fan 01	BPSY	373	B	E0025

NOTE: UNIT I = EQUIPMENT BEING INVENTORIED. UNIT II = EQUIPMENT CONNECTED TO UNIT I.

LEVEL OF IMPORTANCE	CONDITION LEVEL	OPERATING ENVIRONMENT
☒ I Critical	☒ I Satisfatory	☒ I Good
☐ II Important, not critical	☐ II Questionnable	☐ II Fair
☐ III Can be deferred	☐ III Poor	☐ III Poor

MANUFACTURE: Allis Chalmers
MODEL NO.: 123
SERIAL NO.: 1-5103-54537-1-1
CAT. NO.:
FRAME NO.: 365T
TYPE: RG
CLASS:
S.F.:
DES.:
P.H.:
CODE:
SPEC. NO.:
NEMA DESIGN:
H.P.: 75
VOLTS: 200
AMPS.: 201
PHASE: 3
R.P.M.: 1760
DUTY: Cont.
OPER. TEMP. RISE: 40C

COUPLING

☐ Direct
☐ Flex
☒ Belt

BELTS

No. of 5
MFG & I.D.

SHAFT SIZE

Inboard ________ mm Outboard ________ mm

MOTOR BEARING DATA

MFG & I.D.
Inboard 65BC03JPP3
Outboard 65BC03JPP3

☐ Ball ☐ Sleeve ☐ Roller
☐ Open ☒ Sealed

Lube type/MFG

INITIAL BEARING ANALYSIS READINGS

Motor dbi 18	Driven Unit dbi 16
Inboard	Inboard
Outboard	Outboard

COMMENTS:

EXHIBIT # 3

MOTOR LIST

BUSINESS BUILDING

MOTOR ID	HP	MANUFACTURER	LOCATION (ROOM)	DRIVEN UNIT
01	2.0	Buffalo Forge	113	REFP01
02	2.0	Buffalo Forge	113	SOLP02
03	7.5	General Electric	113	CWP03
04	1.5	Century	113	CWP04
05	1.5	Century	113	CWP05
06	1.5	General Electric	113	CWP06
07	2.0	Aurora	113	CNDP07
08	2.0	Aurora	113	CNDP08
09	1/8	Marathon	113	HWP09
10	1/8	Marathon	113	HWP10
11	1.0	Century	113	HWP11
12	2.0	Doerr	113	HWP12
13	1.5	Century	113	HWFC13
14	2.0	Century	113	HWFC14
15	2.0	Century	113	HWFC15
16	3.0	Century	113	HWP16
17	3.0	Marathon	113	ACOM01
18	25.0	General Electric	113	RF01
19	60.0	General Electric	113	SF01
20	15.0	Lewis-Allis	113	CTF01
21	15.0	Century	113	CWP21

EXHIBIT # 3 CON'T

23	vacant			
24	vacant			
25	vacant			
26	1.0	General Electric	500	EF01
27	10.0	General Electric	500	RF02
28	25.0	General Electric	500	SF02
29	10.0	General Electric	501	RF03
30	25.0	General Electric	501	SF03
31	1/4	General Electric	113	EF02

MECHANICAL ROOM

SURVEY

EQUIPMENT LOCATIONS

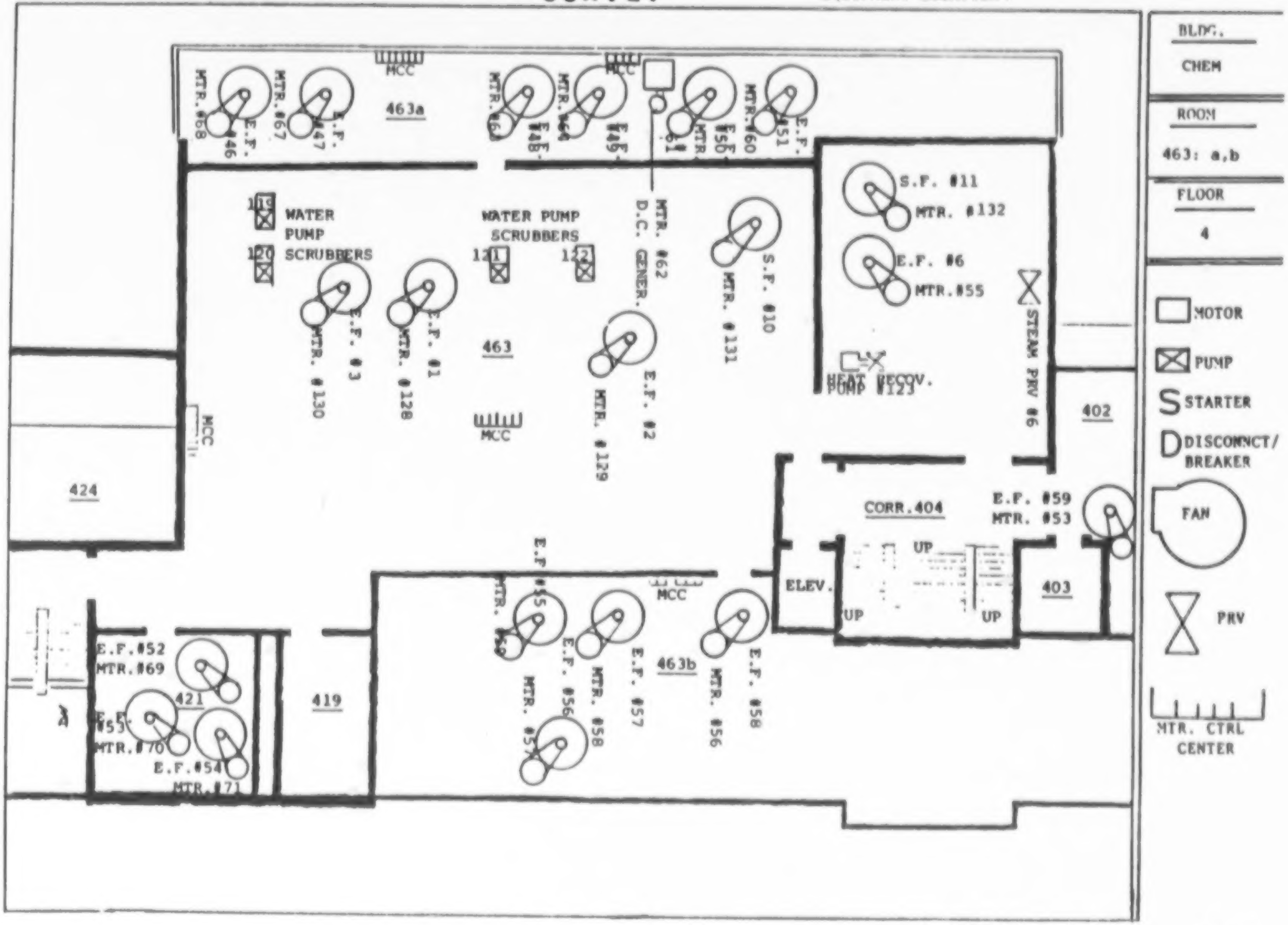

BLDG.
CHEM
ROOM
463: a,b
FLOOR
4
MCC
463a
MTR. #68
E.F. #46
MTR. #67
E.F. #47
MTR. #63
E.F. #48
MTR. #64
E.F. #49
#61
MTR.
E.F. #50
MTR. #60
E.F. #51
119
120
WATER PUMP SCRUBBERS
WATER PUMP SCRUBBERS
121
122
MTR. #62 D.C. GENER.
S.F. #10
MTR. #131
S.F. #11
MTR. #132
E.F. #6
MTR. #55
E.F. #3
MTR. #130
E.F. #1
MTR. #128
463
MCC
E.F. #2
MTR. #129
HEAT RECOV. PUMP #123
STEAM PRV #6
402
MCC
424
CORR. 404
E.F. #59
MTR. #53
UP
ELEV.
UP
UP
403
E.F. #55
MTR. #59
MCC
E.F. #56
MTR. #57
E.F. #57
MTR. #58
463b
E.F. #58
MTR. #56
E.F. #52
MTR. #69
421
E.F. #53
MTR. #70
E.F. #54
MTR. #71
419
MOTOR
PUMP
S STARTER
D DISCONNCT/ BREAKER
FAN
PRV
MTR. CTRL CENTER

EXHIBIT # 4

BEST COPY AVAILABLE

EXHIBIT # 5

TOWNLEY
BUILDING

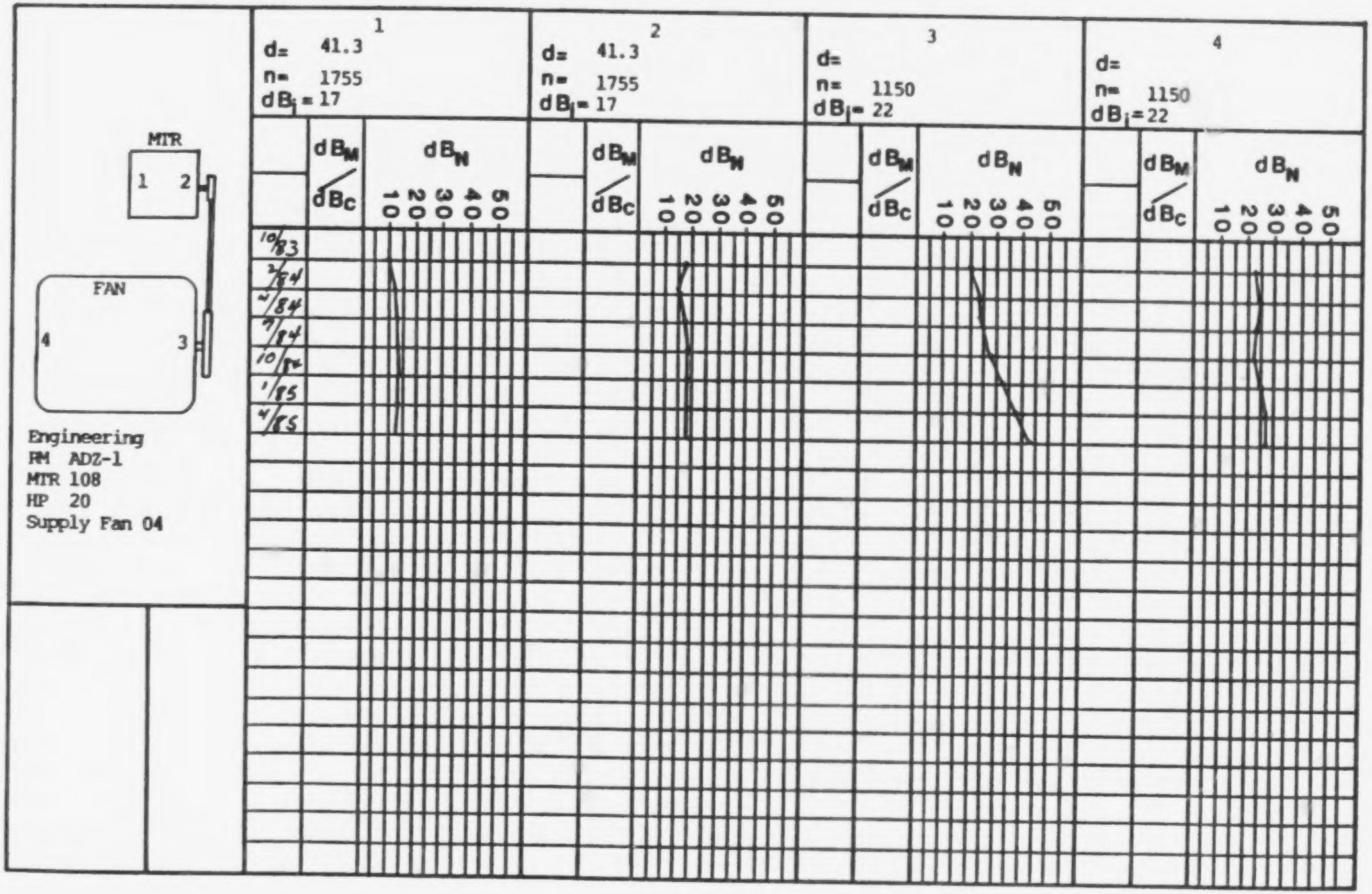
*** ELECTRIC MOTORS ***
EQUIPMENT

*** BUILDING MASTER LIST ***

MOTOR ID	DRIVEN BY	UNIT NO.	ROOM NO.	COMMENTS
01	Condensate Pump	01	C1B42	
02	Condensate Pump	02	C1B42	
03	Condensate Pump	03	N1B77	
04	Condensate Pump	04	N1B77	
05	Hot Water Circ. Pump	05	N1B77	
06	Chill Water Pump	06	C490	
07	Supply Fan	02	C490	
08	Exhaust Fan	01	C580	
09	Exhaust Fan	02	N450	
10	Supply Fan	03	N476	
11	-Open-			
12	-Open_			
13	Air Wash Pump	13	C150	
14	Supply Fan	01	C148M	
15	-Open-			
16	Chill Water Pump	16	N450	
17	Evap. Cooler Pump	17	C490	
18	Exhaust Fan	03	N450	
19	Exhaust Fan	04	N450	
20	Heat Recovery Pump	20	N450	
21	Heat Recovery Pump	21	C580	
22	Exhaust Fan	05	Roof	
23	Air Wash Pump	23	N468	
24	Exhaust Fan	06	Roof	
25	Exhaust Fan	07	Roof	
26	Supply Fan	04	STC409	
27	D.I. Water Pump	27	N1B77	
28	H.W. Water Pump	28	C1B42	
29	C.W. Water Pump	29	C150	
30	Supply Fan	05	C1B42	
31	C.W. Water Pump	31	STC409	

RLO:od/1983

BEARING PERFORMANCE GRAPH



Engineering
RM ADZ-1
MTR 108
HP 20
Supply Fan 04

EXHIBIT # 6

EXHIBIT # 7

PREVENTIVE MAINTENANCE

UNIVERSITY OF COLORADO   FACILITIES MANAGEMENT

INSPECTION STANDARDS

****

FAN SYSTEMS–TYPE I

****

Page 1 of 3

INSP CODE	FREQ CODE	SHOP	(*) INDICATES SHUTDOWN	HRS	MIN
01.0	W		Check sensors for proper operation		30
02.0	W		Check operation of total system	1	20
03.0	W		Check PRV & control air setting (pressure) & PRV safety relief		15
04.0	M		Check static pressure gauges, sensing probes, frames, filter media for excessive dirt and dust		20
05.0	Q		Check heating & cooling coils for obstruction, dirt, leaks, corrosion		20
06.0	Q		Take bearing readings;		
06.1	Q		Ball or roller - use SPM shock pulse meter, record results		
06.2	Q		Sleeve-use SPM vib.10, record results		15
07.0	Q		Sleeve bearings;		
07.1	Q		Remove inspection plug & check oil level - add oil if necessary - record amount of oil added		
07.2	Q		Check operation of slinger rings, replace inspection plug - wipe up bearing housings		
07.3	Q		Check bearing housings for signs of oil leakage		10
08.0	Q		Chain drive systems;		
08.1	Q		Observe condition of chain-level of oil, add if necessary & record - listen for unusual noise		10
09.1	Q		Check hot/cold decks, duct work (where possible) for dust, dirt, possible air leaks, obstruction		30

FREQUENCY CODE DESECRIPTION		TIME REQUIRED	X=	HRS	MIN
DAILY	D	0.00	202		
WEEKLY	W	1.45	52	91	00
MONTHLY	M	.20	12	4	00
QUARTERLY	Q	1.15	4	5	00
SEMI-ANNUAL	S	0.00	2		
ANNUAL	A	0.00	1		
		TOTAL ANNUAL HOURS:		100	00

EXHIBIT # 7 CON'T

PREVENTIVE MAINTENANCE

UNIVERSITY OF COLORADO FACILITIES MANAGEMENT

INSPECTION STANDARDS

****

FAN SYSTEMS-TYPE 1

****

Page 2 of 3

INSP CODE	FREQ CODE	SHOP	(*) INDICATES SHUTDOWN	HRS	MIN
10.0	M		Check operation of air intake dampers, actuators, louvers		15
11.0	S		Check face condition, outside air intake screens for blockage		15
12.0	S		Humidifier System;		
12.1	S		Check valves, manifold, pump, spray heads, float valves		
12.2	S		Check for rust, corrosion, leaks	2	00
13.0	S		Check fan box, chambers, duct work, plenum and terminal reheat system (where possible) for dirt, leaks, ets.	4	00
14.0	A		Lubricate all linkages	1	00
15.0	A		Check operation of auto valves, vacuum breakers, traps for blow thru	1	00
16.0	A		Check system fittings, connections and tubing for leaks or defects	1	00
17.0	A		(*) Caution observe shut down procedures		
17.1	A		(*) Clean fan wheel and cabinet		
17.2	A		(*) Check for fin/blade damage (record & report)	3	00
17.3	A		(*) Check for worn sheaves, worn belts, loose belt guards, proper belt tension, loose motor & fan mounts		30
17.4	A		(*) Check belt/sheave alignment (motor & fan)		30

FREQUENCY CODE DESECRIPTION		TIME REQUIRED	X=	HRS	MIN
DAILY	D	0.00	202		
WEEKLY	W	0.00	52		
MONTHLY	M	0.15	12	3	00
QUARTERLY	Q	0.00	4		
SEMI-ANNUAL	S	6.00	2	12	00
ANNUAL	A	7.00	1	7	00
		TOTAL ANNUAL HOURS:		22	00

EXHIBIT # 7 CON'T

PREVENTIVE MAINTENANCE

UNIVERSITY OF COLORADO FACILITIES MANAGEMENT

INSPECTION STANDARDS

****

FAN SYSTEMS TYPE - 1

page 3 of 3

****

INSP CODE	FREQ CODE	SHOP	(*) INDICATES SHUTDOWN	HRS	MIN
17.5	A		(*) Sleeve bearings - drain oil from reservoirs, check for babbet residue, clean sight glass, flush and refill with oil to proper level, wipe down	1	00
17.6	A		(*) Ball-roller bearings - clean grease & dirt from zerk and bearing housing - add grease slowly until grease film appears at seals (if possible turn fan slowly) wipe down bearing housing		30
17.7	A		Observe start-up procedures; Sleeve bearings - observe operation of slinger ring, replace inspection plug		15
17.8	A		Ball-roller bearings - check to see if metal mechanical seal is rotating - wipe down any excess grease		15
18.0	A		Fan balancing - using PMC vibration analyzer, take vertical & axial readings where possible and record results	2	00

FREQUENCY CODE DESECRIPTION		TIME REQUIRED	X=	HRS	MIN
DAILY	D	0.00	202		
WEEKLY	W	0.00	52		
MONTHLY	M	0.00	12		
QUARTERLY	Q	0.00	4		
SEMI-ANNUAL	S	0.00	2		
ANNUAL	A	4.00	1	4	00
		TOTAL ANNUAL HOURS:		4	00

Grand Total 126.00

EXHIBIT # 8

UNIVERSITY OF COLORADO, BOULDER
Department of Facilities Management

SHUTDOWN REQUEST

WORK ORDER #________________ REQUEST DATE___/___/___ SHOP______

TYPE OF UTILITY OR UTILITIES TO BE SHUTDOWN (EQUIPMENT I.D. MUST BE LISTED):

LOCATION OF SHUTDOWN:________________
(BUILDING)

AREAS/FLOORS IN BUILDING AFFECTED BY SHUTDOWN:________________

LENGTH OF TIME DOWN:__________ (NO. OF DAYS) __________ (DATES)

HOURS: START AT __________ BACK ON __________ DATE:___/___/___

REASON FOR SHUTDOWN:________________

SHUTDOWN REQUESTED BY:________________

AUTHORIZED SIGNATURE:________________
(FACILITIES MANAGEMENT)

BUILDING PROCTOR APPROVAL:________________ (PROCTOR SIGNATURE) / __________ (DATE)

COMMENTS:________________

cc: Tom Cowin

RLO/yh:4/85

Stadium 255 • Campus Box B-53 • Boulder, Colorado 80309 • (303) 492-5511

EXHIBIT # 9

UNIVERSITY OF COLORADO
PREVENTIVE MAINTENANCE

- FAN BALANCING -

WORK ORDER ______________

FAN I.D. ______________

MOTOR I.D. ______________

DIA. FAN WHEEL ______________

DATE SCHEDULED FOR BALANCING ____/____/____

BUILDING ______________

FLOOR ______________

ROOM ______________

	DATE	TIME
START	/ /	
STOP	/ /	

PRIOR TO SHUTDOWN (Check Each Item When Completed) **SHUTDOWN**

______ Issue Work Request
______ Complete Shutdown Request and Obtain Signatures
______ Issue Copies of Shutdown Request To Energy Management, HVAC Shop,
______ Arrange for additional help
______ Inform Filter Changers

Gather Tools, Test Equipment, Materials

______ PMC 208
______ H.P. 41 CV
______ SPM Meter/Vib. 10
______ Wet Dry Vac
______ Drill & Bits
______ Extension Cord & Trouble Light
______ Cleaning Brushes
______ Degreaser
______ Soap
______ Bearing Grease/Oil
______ Weights
______ Straight Edge
______ Plastic Bags (Small)
______ Putty Knife
______ CFM Measuring Instrument
______ Work Sheets
______ Buckets for Water
______ Garden hose

______ Lock-out Disconnect
______ Remove Drive Belt(s)
______ Lock Shaft to Prevent Chimmney Effect
______ Examine Condition of Belts and Sheaves
______ Examine Coils, Filters For Dirt Build-up
______ Clean and Flush Bearings/ Replace Grease/Oil
______ Photograph Interior of Fan Box
______ Remove Dirt Sample from Fan Wheel for Weighing
______ Clean Fan Wheel and Fan Box
______ Vacuum Up Dirt
______ Mark Blades
______ Remove Shaft Lock and Replace Belt(s)
______ Align Sheaves and Belts
______ Balance Fan and Record According to Fan Balancing Work Sheet
______ Clean-up Mechanical Room, Vacuum-Wet Mop
______ Advise Proctor of Possible Dust When Fan is Started Up

COMMENTS: ______________

1/85:RLO

BEST COPY AVAILABLE

EXHIBIT # 10

/ /
Date Issued

UNIVERSITY OF COLORADO
FACILITIES MANAGEMENT
PM WORK ORDER

Work Order No.____________ Equip. ID____________
Bldg.____________ Floor______ Room______
Shop____________ Freq.______ Due Date______
Last Insp. / / Next Insp. / /

Insp. Code	Inspection Standards	Hours	Min.
	Totals:		

Readings:________________________

Comments:________________________

____
Mechanics Signature

/ /
Date

FACILITIES MANAGEMENT
PREVENTIVE MAINTENANCE
EQUIPMENT SUMMARY (BY UNIT)
(P.M. RPT 1.0)

REPORT DATE: ___/___/___

BUILDING: ______________________

PERIOD OF REPORT __________ TO __________

* * *

CLASS: Electric Motors

UNIT I.D.	ROOM NO.	INSTALL DATE		ACTUAL P.M. COST				OTHER COST			YTD COST	PRIOR YEAR COST	TOTAL COST	EQUIP. VALUE
			HOURS	LABOR	MAT'L	TOTAL	HOURS	LABOR	MAT'L	TOTAL				
02	D0065	3/75	3.0	$ 50	$ 25	$ 75	19	$275	$675	$950	$1,025	$ 200	$2,250	$ 800*
03	D0065	3/75	20.0	300	50	350					350	75	425	1,500
04	D0065	5/78	10.0	150		150					150	85	235	500
CLASS TOTAL:			33.0	$500	$ 75	$575	19	$275	$675	$950	$1,460	$ 360	$2,910	$2,800

EXHIBIT # 11

FACILITIES MANAGEMENT
PREVENTIVE MAINTENANCE
EQUIPMENT P.M./REPAIR DETAIL
(P.M. RPT 2.0)

REPORT DATE: ____/____/____

BUILDING: Muenzinger

CLASS: Electric Motors

PERIOD OF REPORT ________ TO ________

* * *

UNIT I.D.	ROOM NO.	WORK ORDER	DATE OF WORK	DESCRIPTION OF WORK	SHOP	HRS.	LABOR	MAT'L
02	D0065	14361	07/07/83	Check Alignment	10	1.0	$ 15	-0-
02	D0065	14361	07/07/83	Megger for proper insulation	10	1.0	15	$ 25
02	D0065	14480	07/10/83	Replace Bearings	15	6.0	100	50
02	D0065	15002	08/01/83	Check Temperature	10	.5	10	-0-
02	D0065	15020	08/10/83	Take vibration readings	10	.5	10	-0-
02	D0065	15075	08/15/83	Replace motor mounts	15	5.0	50	75
02	D0065	16120	09/08/83	Rewind motor	50	-0-	-0-	400
02	D0065	17520	09/30/83	Replace shaft	15	8.0	125	150
TOTAL						22.0	$325	$675
03	D0065	17310	08/12/83	--				

NOTE: Shop 10 is the P.M. Shop.

The detail portrayed above is a breakdown of motor #02 on the sample summary report #1.0

EXHIBIT # 12

REPORT DATE: ____/____/____

FACILITIES MANAGEMENT
PREVENTIVE MAINTENANCE

BUILDING SUMMARY

(P.M. RPT 3.0)

PERIOD OF REPORT __________ TO __________

****

	ACTUAL P.M. COSTS			OTHER COSTS					
BUILDING	HRS.	LABOR	MATERIAL	HRS.	LABOR	MATERIAL	YTD COST	PRIOR YR. COST	EQUIP. VALUE
Armory	75	$1,150	$ 150	15	$ 150	$ 20	$ 1,470	$ 300	$ 75,000
Business	300	3,500	1,700	190	2,500	3,000	10,700	1,500	200,000
Chemistry	95	975	80				1,055	2,000	150,000
Computer	20	200		10	200	50	450	500	75,000
Dennison	50	150	180				230	200	50,000
TOTALS	540	$5,975	$2,110	215	$2,850	$3,070	$13,905	$ 4,500	$350,000

EXHIBIT # 13

EXHIBIT # 14

FACILITIES MANAGEMENT
PREVENTIVE MAINTENANCE
POLICY AND PROCEDURE

WORK ORDER
(F/M P.M. 12.0)

BASIC POLICY: The Work Order will be a computer printed document that will facilitate planning, controlling, assigning work and evaluating equipment condition.

PROCEDURE: P.M. Work orders will be issued at the prescribed frequencies and distributed to appropriate Foremen for distribution to the Mechanics. The Work Order will:

1. Be the authorization for job assignments.
2. Provide equipment identification, location and work instructions .
3. Be a permanent record for reference as well as an input document, whereby information supplied by the Mechanics will update files for reporting purposes.
4. Give Mechanics opportunity to add, change, delete frequencies and Inspection Standards as necessary, and to record various readings or make comments.
5. Provide supervision with a means to plan work schedules.

EXHIBIT # 14 CON'T

WORK ORDER (continued) (F/M P.M. 12.0)
PAGE 2

REFERENCE: Frequency Codes/Inspection Standards/Data Element Description/Inventory File.

RESPONSIBILITY: Systems Group: Issue P.M. Work Orders and Work Order Summary Report as prescribed by established frequencies. P.M. Office: Disbribute Work Orders to appropriate crafts, process completed Work Orders, follow-up on incomplete Work Orders.

FILE: Shop File of completed Work Orders. P.M. office input copy.

DISTRIBUTION: To Foremen

SAMPLE P.M. WORK ORDER FOLLOWS:

Managing the Physical Plant in an Organized Anarchy

by Robert A. Francis
Vice President for Campus Operations
State University of New York
at Stony Brook

The purpose of this paper is to give you some suggestions about getting your ideas implemented when you work at a college or university, where the decision-making process often seems mysterious. James March and Michael Simon, who are concerned with problems of the college presidency, fondly call colleges and universities organized anarchies because of the way the places where we work do business. Administrators and faculty are often unsure about what they should be doing because they don't have the comfort of profit and loss to guide decision making. Knowing who has the power to implement decisions is not always clear. And knowing when success has been achieved is difficult for presidents. The product of higher education is hard to define, particularly in terms of quality. These issues also apply to physical plant managers in colleges and universities. The complications of a service professional's career in higher education are compounded by the characteristics of the organized anarchy.

Things sure are different from those heady days in 1970 when I took my first job teaching Freshman Composition: my university couldn't spend money fast enough. The pressures most of you have lived with for at least ten years to cut costs and staff but continue desired services have often conflicted with your professional standards and induced stress. After all, you have spent the longest phase of your career grappling with the effects of the oil embargo, double digit inflation, deep recession, and now enrollment declines which may not stabilize until 1995 for most of you. You have been cutting overhead for most of your professional lives, and it hasn't been much fun.

Characteristics of An Organized Anarchy

Knowing exactly what you're supposed to do is hard for a plant manager. The job description says you're supposed to maintain the buildings and grounds in the best possible condition within available resources, but that mission statement won't always help you when other people disagree about what the mission statement means. In my career I've been criticized for not cleaning snow off the walks quickly enough after implementing a directive to reduce overtime, for not maintaining a proper classroom environment after effecting an energy conservation program, and for not keeping the restrooms clean at night after reducing the custodial staff by 10 percent. We all deal with the occasional feeling that we are expected to keep constituents happy rather than provide proper plant services within a given budget. Knowing what is expected of you is a fundamental security need. In an organized anarchy doing things right is difficult enough, let alone doing the right thing.

Next, it's hard to know exactly who's in charge. The chain of command on the organization chart is too abstract. I've been told by a president to do a minor construction job only to have work stopped by a faculty member whose concentration was disturbed. I once changed arrangements for protecting Senator Kennedy after students complained they wouldn't be able to get close enough to demonstrate effectively. I had to delay reassignment of personnel from one work location to another, a clearly understood management right, after a union official complained to a central administrator in the state capitol. We all occasionally believe that we are denied the authority to carry out our responsibilities. Knowing who has decision-making authority is also a fundamental security need. Our power base is often not clear.

Finally, knowing when you've achieved a worthwhile goal is tough. When things are working perfectly, no one seems to notice; but the slightest complaint can turn into a major criticism of performance. For example, I can't achieve successful temperature control in the customers' eyes during the transitional seasons: If I air condition I get calls from people who are cold in the morning; if I heat I get calls from people who are hot in the afternoon. In another instance, the same chairman who complained to me last fall that his building wasn't locked at night just called me to complain that he never knew which door would be unlocked when he arrived in the morning. We all need occasional reinforcement of the dominant need of professionals: certification of competence. This need becomes important after the security issues are resolved. We self-actualize when we positively assess our competence, achievements, and professional growth. But our achievements are often not clear.

Living with Frustration

Your mission, authority, and measures of success are often ambiguous. The uncertainties of plant management are compounded by the inevitable frustrations of dealing with governance processes in an organized anarchy.

First, keeping faculty or management attention focused on physical plant issues is difficult. Faculty members belong to their own disciplines first. They are your committee members or supporters after seeing their students, doing research, and attending departmental business. Senior administrators, constantly being drawn away from you toward many other issues of the moment, seem to give lower priority to physical plant matters. I've had trouble getting faculty groups and colleagues to help set priorities on capital improvements only to get urgent calls months later to restore the heat after a heating coil low on the priority list failed. I've sounded warnings throughout a fiscal year about the need to trim demand for services performed on overtime, only to be asked to slow it down with two months to go. You are drawn in many directions by your work, unable to give the time needed to all problems you face. In fact, you have learned to select only a few important tasks to work on at one time. So do the people who make decisions important to us in an organized anarchy.

Because issues fade quickly from peoples' minds and faculty can never devote enough time to urgent governance tasks, the governing mechanisms of a college or university are easily overloaded. The governance system doesn't have enough energy to address every topic brought to its attention. I have at least five hot items on the agenda of our Campus Environment Committee right now, including approving schematic drawings for a project, fixing the location of a railroad station platform, and making recommendations on a land use policy. These responses will need to be discussed next by trustees or community groups. You all experience the destabilizing effects of your own heavy workloads. But you are also affected by others' backlogs. The decision-making system is always overloaded in an organized anarchy.

But you can be sure that special interest groups will always have time and energy to devote to issues you are trying to promote. And any proposal can become a whipping post for any special interest. I have had a proposal to reduce lighting intensity to state standards opposed by both a women's safety committee concerned about attacks and athletes arguing for night lighting for softball fields. My efforts to provide security during a complex debate over academic freedom were at different times supported and opposed by minority organizations and religious groups, depending on whose meeting was being protected. We all do business with lobbyists for the many intellectual positions current in academe. Every decision in the organized anarchy can be influenced by persons who represent narrow points of view.

When you are faced with opposition at the very time you have the attention of people whose attention is hard to get you learn how important but difficult it is to have adequate information to support your position. A tactic often used by critics is to ask quantitative questions. When I propose a new initiative I am often asked what the other sixty-three campuses of the State University of New York do. I was recently asked how much was spent in 1972 to install kitchenettes in dormitories, how many fires occurred on campus over the last ten years, and how many thermostats were originally installed in a major building. Of course, I couldn't answer any of these questions precisely. We all are bothered when we can't get or provide solid quantitative answers even to the most obscure questions. We tend to feel that we haven't prepared well enough. Such questions get asked often in an organized anarchy.

After you have overcome the obstacles of attention, special interests, and information, and get the decision you want, you can still be overwhelmed by how slowly needed change comes. After getting agreement to close the campus between midnight and 5:00 a.m., I waited two years through one annoying but understandable delay after another for the posts, chains, and caution lights to be installed. A decision I worked for to build a radioisotope receiving facility, delayed because of funding problems, never was implemented. I've seen many space reallocation plans reversed before they were put into effect. We all chafe at the time our institutions take to make changes because we know that each delay or postponement works against change. The decision making and implementing metabolisms are glacial in an organized anarchy.

Methods of Achieving Goals in an Organized Anarchy

The characteristics of decision making in colleges and universities add to the frustrations plant managers feel in dealing with the everyday problems of directing a service organization. Rather than fight the nature of higher education, a battle which you will inevitably lose after your strength is gone and your spirit broken, I advise using the frustration-inducing qualities of the system to your advantage.

First, because few faculty and administrators have time to devote to your issues, you are in the best position to control those topics. You have the greatest energy to devote in an energy poor environment. You can develop needed information supporting your proposal to communicate to people in the decision-making process, knowing what questions may be asked of you. Opponents of your position, who have to devote energy to their own departmental workloads, cannot give enough time to the issue to block a rational position for very long. My best example is the selling of a custodial staffing pattern based on weighted square footage per cleaner. Building managers and occupants who were to lose service allocated in a more political context could not keep the same schedule of meetings I did. Over a period of months I made adjustments to the model to respond to technical comments, accommodating a number of objections. Within a year the plan was in effect. The organized anarchy, because it is energy poor, rewards sustained effort.

The next point is that you must persist with your ideas. A year is not, in my opinion, too long to wait to implement a staffing plan or other important program. I have been working on some fee proposals in stages for much longer. I like to point out how much time and effort was spent by generations of dedicated, energetic spirits to gain a legal basis for civil rights in our country. Regarding any collective bargaining contract question, three years may be a short time for fostering change. You may find the forces against you today too strong to overcome; but participants in the discussions change over time. You must plant the seeds of your the seeds of your ideas where you can, nurture the people who accept them, and plant again for the new and the old players. I have seen presidents change their minds on major plant issues with the passage of time. And compromise to establish a principle. If you don't get all of what you want now, you will get another chance. I recently agreed to issue parking decals good for three years rather than one in exchange for the implementation of a $2.50 vehicle registration fee. Of course I'm not recovering my costs now, but three years will pass quickly. The organized anarchy rewards endurance.

Exchange status for progress by giving credit to other people when your program is successful. Make sure the mechanical engineering professor who chairs the energy conservation committee gets credit for saving the college money. Tell the student newspaper that the student government president got the money for you to increase lighting in the parking lots. Most participants in the decision-making process have social and esteem needs which are not fully satisfied by their departments. If you meet these needs the participants, for whom the outcome of a plant management decision is usually not critical, may willingly meet your needs. This is consistent with Skinner's theory that behavior will be repeated when reinforced. Having met someone else's esteem needs, you will find that more positive attention is given to your projects in anticipation of the reward. If possible, let your proposals be identified with influential people or committees within the governance structure rather than yourself. If your idea is successful you get what you want, if not successful you don't carry the burden. The Chinese philosopher Lao Tzu would say you have done well if others believe they have done the job themselves. Paradoxically, you can succeed by avoiding status, one of the few measures of success in an organized anarchy.

In exchanging status for progress you will want to use governance structures often. The organized anarchy thrives on consultation. I have seen major curriculum proposals wanted by administrators and faculty founder over questions about how much consultation is enough. I have seen the faculty vote against filling an administrative position that was created only because the faculty wanted it. But the curriculum proposal went through and the administrative position was filled because many other items dotted the governance agenda. Governance systems, which are energy poor, get overloaded easily. If you keep your committees overloaded with requests for review, advice, and consent, some things have to go through. So never keep a proposal away from the organized anarchy because you already have it too busy.

Get the people who have special interests involved in your committees. They'll be involved anyway. You might as well organize the discussion so the special interest groups have partial ownership of the decision and are therefore committed to making the program work. A compromise which works is better than a pure program that is opposed when implemented. I always include an officer of the labor union on a search committee for a director or assistant director. Students who have taken the time to come to me in person to reappeal a parking ticket after being denied by by the Traffic Appeals Board make excellent appointments to that committee. Bicyclists make great consultants on pathway designs. Disabled persons can help you set priorities for plowing snow from walks. Special interests have much in common in an organized anarchy.

Finally, as you pursue your programs interpret history. Most participants in the decision-making process will have little knowledge of your issues. And because good information is hard to get, you are in the best position to provide the needed background. The residence life committee complaining about the backlog of dormitory repairs needs to know that you cut staff last year while the residence life department was spared. The athletic faculty who want you to do more field maintenance need to know you gave two groundskeepers to the athletic director ten years ago because he wanted to control the work. Summarize often because the organized anarchy has a short collective memory.

I hope you will be able to incorporate some of these suggestions into your management planning to use the perceived disadvantages of the collegiate decision-making process to your benefit. Thank you.

Kriemelmeyer

Lopes

ASBESTOS. A HAZARD IDENTIFICATION AND TRAINING PLAN FOR COLLEGES AND UNIVERSITIES

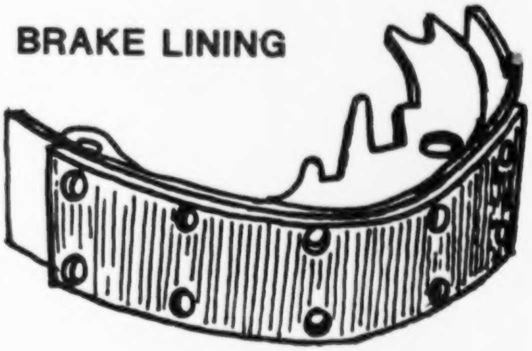
Harry Kriemelmeyer
Director/Physical Plant
University of Maryland

William J. Lopes
Asst. to the Dir./Trng., Safety, & Health
University of Maryland

WHAT IS ASBESTOS?

Asbestos, the common name for a group of naturally occuring minerals called silicates, has been mined by man for many uses over the past seventy years. The ore as it is mined contains many thin, but strong fibers. These fibers are stripped from the ore and then are milled for commercial use.

There are six asbestos minerals that are used commercially: Chrysotile (white asbestos), Amosite, Crocidolite, Anthophyllite, Tremolite, and Actinolite. Chrysotile accounts for about ninety-four percent of all commercially used asbestos.

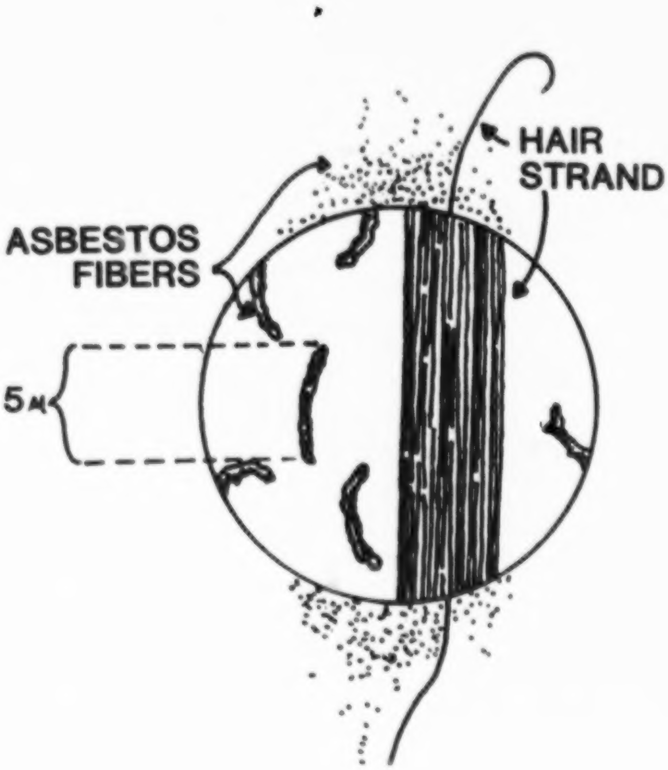


Favorable properties of asbestos include durability, flexibility, strength, and resistance to wear. Man has used asbestos in over three thousand ways. Some of the most well known uses are: roofing and flooring products; fireproofing textiles, friction products, such as brake linings, reinforcing materials in cement, pipes, sheeting, and coating materials; thermal insulation, acoustic insulation; and fire doors.

THE CONTROVERSY

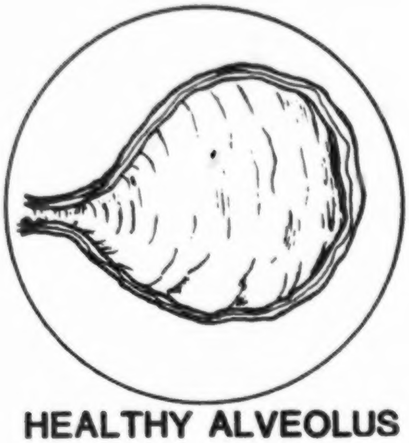
We are concerned about asbestos and its uses now for the same reasons that have made it useful: the durability of the fibers--they can not be easily degraded or destroyed and they last almost forever; their small size; and their fibrous shape. The size and fibrous shape of asbestos particles allows them to remain airborne for long periods of time.

To illustrate a major problem with airborne asbestos fibers, imagine a ray of sunshine coming through a window. One can see dust particles floating in the air which are made apparent by the bright light. Asbestos fibers that you might breathe in air and that could cause health problems are many times smaller than household dust, and can not be seen by the naked eye. Because they are so small (five microns or less), it takes a very long time for them to settle, and any small breeze can cause them to become airborne again. Asbestos fibers can not be easily broken down or destroyed, so they are likely to be around for a very long time.



It is not known what amount of asbestos is hazardous, or over what period of time, or what a safe level of exposure, if any. But detectable amounts of asbestos fibers in air might pose a health risk and deserve consideration.

ASBESTOS-RELATED DISEASES



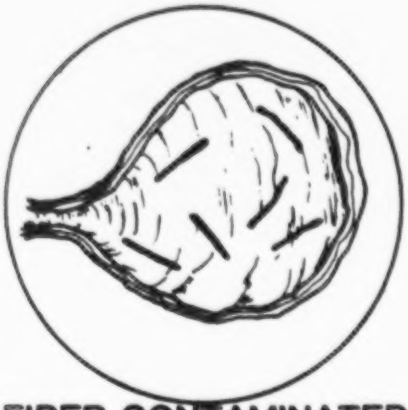
HEALTHY ALVEOLUS

Long exposure to very high concentrations of asbestos can lead to one of the diseases associated with the inhalation of asbestos fibers, called Asbestosis.

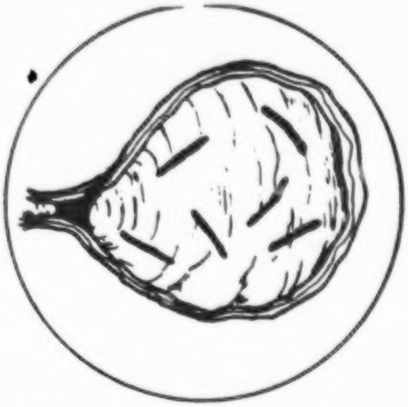
Asbestosis has shown up in shipyard workers from the 1930's and '40's. These are people who sprayed asbestos containing materials or worked with asbestos in small, confined areas, without proper ventilation or protective breathing apparatus.

When asbestos fibers are introduced into lung tissue, they affect the alveoli, or air sacs in which carbon dioxide is exchanged for oxygen. The body attempts to expel the fibers as it would try to get rid of any foreign material. Since attack by macrophages or other body defenses will not break down the fibers, the body reacts in a different way. Scar tissue forms around the entrance to the affected alveolus and closes it off.

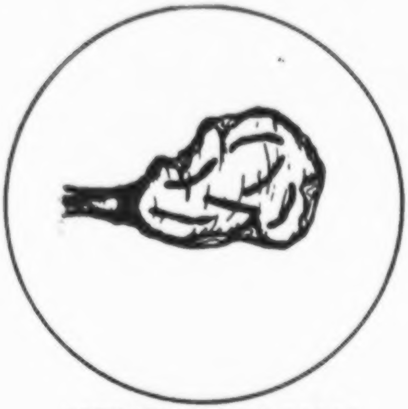
When this happens, the air sac can no longer be used for air exchange. If many alveoli are affected, fewer alveoli are available for the body to get the oxygen it needs to live, so one must breathe harder.



FIBER CONTAMINATED ALVEOLUS



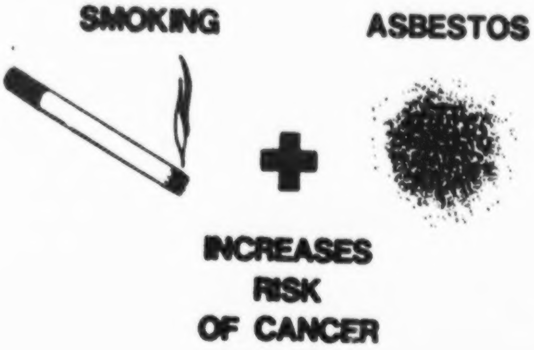
SCAR TISSUE FORMED



NONFUNCTIONAL ALVEOLUS

Mesothelioma is the disease linked to asbestos exposure which has caused much controversy. Mesothelioma is a cancer of the lining of the lungs. Unfortunately, no one knows exactly how much asbestos to which one may be exposed to before one may develop this type of cancer.

Asbestos has a high cocarcinogen effect with cigarette smoking. Studies have shown that people who work with asbestos, smoke, and do not use proper protective equipment, have as much as a ninety-times greater risk of developing mesothelioma compared with a control group.



RISKS OF EXPOSURE TO ASBESTOS

It is impossible to specifically quantify the amount of risk there is due to asbestos fiber exposure. Four factors play a significant role in determining who may develop an asbestos-related disease:

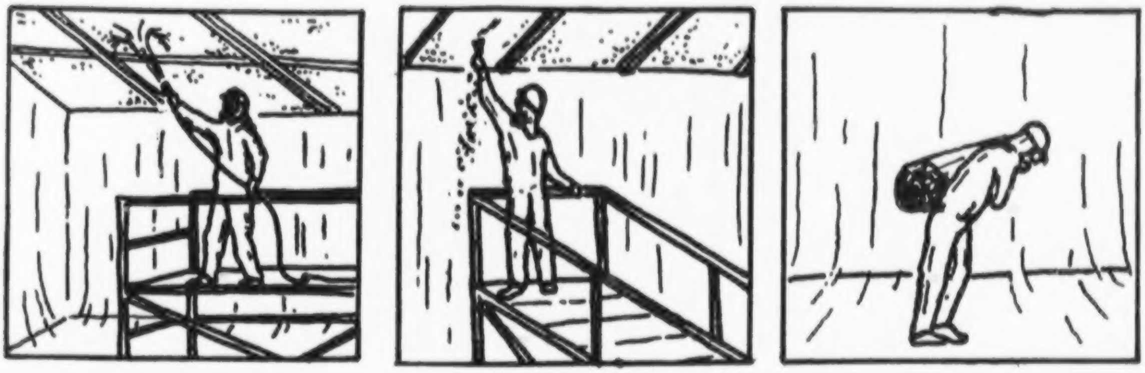
1. Prolonged latency period: The length of time between initial exposure to asbestos and the appearance of an associated disease can be as long as forty years.
2. Lack of low-level exposure data: Data has not been collected long enough to determine what effects low levels of exposure to asbestos can have over time.
3. Effect of co-carcinogens: Data is not determinative on the true effect of cigarette smoking, asbestos exposure, and other cacinogenic environmental factors.
4. Variability of human response: Each person responds differently. Some workers will never develop a disease while others could be affected at a young age.

Treatment

There are four methods of treating asbestos-contaminated materials. The recommended method is REMOVAL. Once removed, one no longer has the problem with which to contend.

Workers who remove asbestos must be trained thorougly in the proper methods and procedures. This report does not give directions on removal or the required training. The local office of the Occupational Health and Safety Administration (OSHA) can provide assistance and recommendations for safely removing asbestos-containing materials.

REMOVAL STEPS



WETTING **SCRAPING** **DISPOSAL**

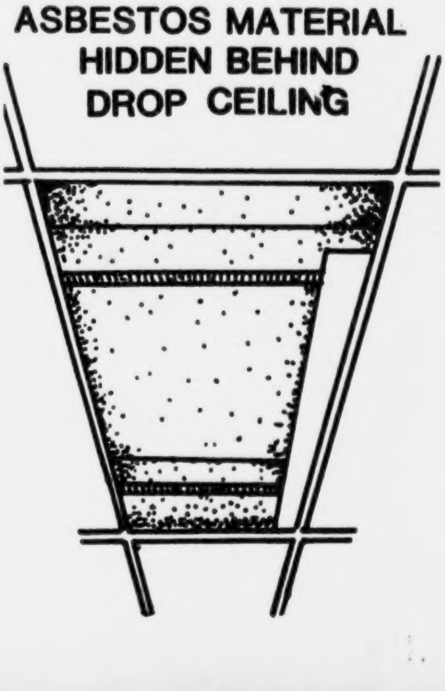
Two alternative methods of treating asbestos-containing materials are ENCAPSULATION and ENCLOSURE. If either of these methods is chosen, the problem still remains -- and could potentially be more hazardous because the remaining asbestos could be easily forgotten about. Encapsulation means covering the asbestos with a material designed to bond to the exposed material and thus bind asbestos fibers, supposedly preventing fiber release. This method has not been entirely successful at the University of Maryland at College Park and is avoided on open area asbestos whenever possible.

Enclosure means constructing a barrier between the asbestos-containing material and the environment. This method is only chosen when there is absolutely no possibility of ever having to disturb the asbestos-containing material again. Usually enclosures are sheetmetal constructions placed around structural support beams onto which asbestos has been sprayed. The enclosure should not contain any moving parts or active elements. Steam and hot water pipes have been enclosed with general success using canvas casing. However, removal of asbestos is a necessity around areas of steam reducing stations and valves.

The final method of treating asbestos-containing materials is deferring immediate action to the material. This is not an actual treatment, but is chosen when limited budgets are stretched to fund removal of high priority areas.

RATING AND PRIORITIZING CONTAMINATED AREAS

Most facilities constructed before the 1970's have problems with asbestos-containing materials being located in them. Unfortunately, removal of these materials is quite expensive. Therefore, persons responsible for deciding what action to take must rank and prioritize the affected areas and begin removal from high priority areas first.


ASBESTOS MATERIAL HIDDEN BEHIND DROP CEILING

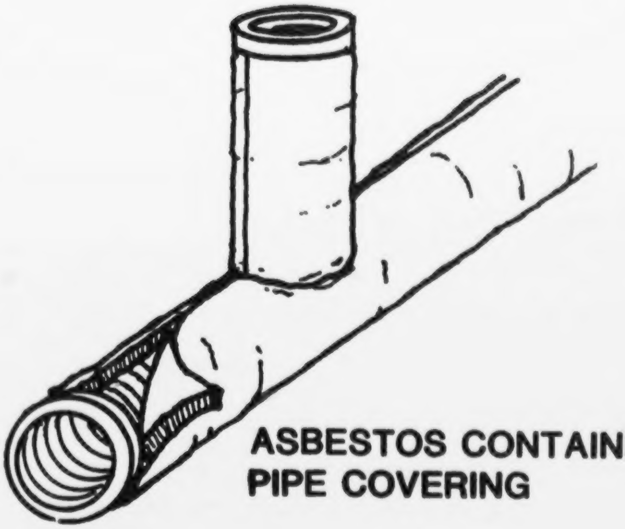
The first order of business is to identify all suspected asbestos-containing materials. Asbestos can be found in some unusual places, such as air plena, ceilings, walls, floors, as well the areas one may expect--pipe coverings, duct coverings, etc.

During the identification phase, one must look particularly for friable asbestos-containing materials. Friable materials are those which can easily be crumbled or pulverized in the hand.

The second step is to take samples of the suspected materials. Actual pieces of suspected materials or core samples should be obtained.

3 0

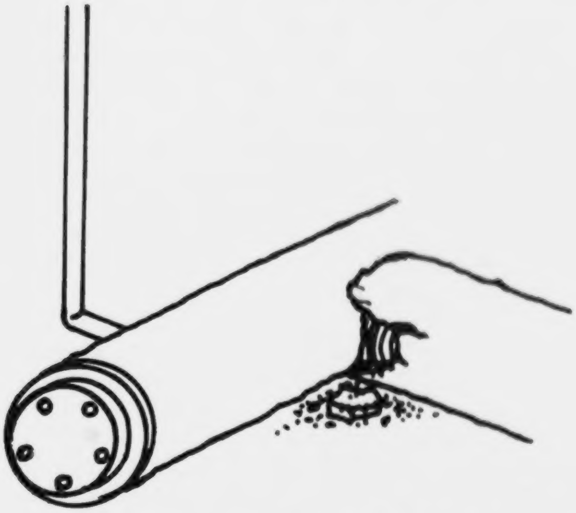
Next, have the samples analyzed by a lab. The lab results should identify the particular type(s) of asbestos present and the percentage of asbestos in the sample.


ASBESTOS CONTAINING PIPE COVERING

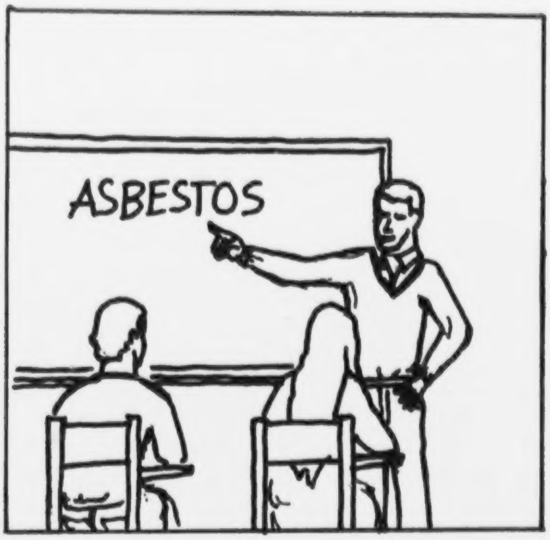
An exposure assessment must be conducted next. The exposure assessment consists of a comparative rating of nine factors:

1. Material Condition: What condition the material is in (loose, friable, or stable).
2. Water damage: Water damage can cause asbestos-containing material to become heavy and fall from its location.
3. Exposed Surface area: An area that has a drop ceiling present is less of a hazard than an area without such a ceiling.
4. Accessibility: How easily the asbestos-containing material can be accidentally disturbed.
5. Activity level of occupants: The more activity in an area with exposed asbestos is of greater concern.
6. Intensity of use of an area: The more an area is used, the greater concern.
7. Air plenum: Asbestos containing materials lining supply or return air systems is of great concern.
8. Percent of Asbestos content: The higher, the worse problem.
9. Friability: This influences how easily asbestos fibers can become airborne.

Once the exposure assessment is complete, a committee should be formed to evaluate the ratings made. Some factors such as friability, water damage, air plena, and percent of asbestos content, should be weighed more heavily than others. The committee should decide the weighting factors and assign a numerical method of determining ratings. Priorities should then be assigned based on these ratings.


FRIABLE ASBESTOS

TRAINING



All employees in a maintenance organization should be made aware of the factors presented in this report: What asbestos is, why there is so much concern about exposure, what health effects are possible, how determinations are made for prioritizing treatment, what treatment methods are being considered, and any specific rules, policies, or procedures that affect how they should handle incidental asbestos exposure.

The training program should show specific examples of what asbestos looks like, where it is found, and what is being done about it. The trainer should always "come clean" with the audience; ie., discuss all issues with honesty. Employees can tell quickly if information is being withheld from them. They should be told what to do if they must disturb asbestos-containing materials during their normal course of work. They also should know the procedures for reporting possible asbestos-containing materials both during the regular work day and after hours.

Training for all employees is essential to provide a common background and understanding for all. Fewer incidents of improper removal or contamination should follow a well-maintained training program.

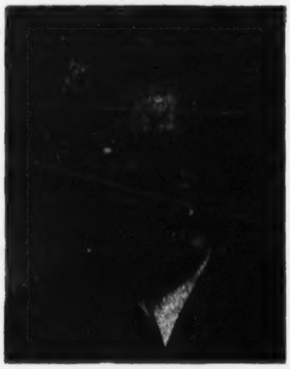
Further Information is available from the following sources:

Occupational Health & Safety Administration
(Look in "Government" Listings under "Labor Department" in the telephone directory)

International Association of Heat & Frost Insulators & Asbestos Workers
1300 Connecticut Avenue, NW
Suite 511
Washington, DC 20036

The prioritizing system and recommentations for an Asbestos Control Program were developed by the Department of Environmental Safety at the University of Maryland at College Park. This department is also credited for its assistance with the technical material contained herein.

Drawings contained in this report were drawn by Mr. William E. Kirwan III, Student Assistant, University of Maryland, Department of Physical Plant.



Leadership -- The Difference

Jerry Boyea
Director of Facilities Management
Bradley University

Leadership - and its relationship to productivity - is a timely subject for plant managers. We are increasingly faced with the difficult challenge of planning and operating in a time of fiscal retrenchment. We are required to use our influence in responsible and creative ways. So I am going to try to provoke your thinking about leadership, with the hope that you will go home and provoke some other people to think about it, too.

You will find that I know very, very little about leadership, although I have been studying it in great detail for some 20 years. I believe that leadership is everywhere - it's in this room, it's in the coffee shop, it's at the University of California-San Diego campus; it's in the classrooms, it's in the dormitories. Wherever you look leadership is being demonstrated. I believe that leadership is continuous - 24 hours a day, 7 days a week. I believe leadership is impartial, available to all, from top to bottom, male or female, black or white, old or young. And I believe that leadership is a requirement for the role of physical plant director of facilities manager.

There is no greater need for leadership than during the time of change. What direction that change takes is dependent on leadership ability. Are you prepared for the changes so clearly expressed in books like Megatrends and The Third Wave and Crumbling Academe, by management specialists like Peter Drucker and Harvey Kaiser? Franklin Delano Roosevelt warned, "Without leadership, alert and sensitive to change, we are all bogged up and lose our way." Is your physical plant "all bogged up?" Do you feel that you have "lost your way"? If so, you need to focus on leadership.

Leadership is a very low cost item that can multiply productivity. The cost is simply your time. But you have to learn to recognize it. Look for leadership wherever you are - at the library, in church, at your civic club meeting, at this APPA convention. Watch it in action, choose the parts you like, apply them to your concerns of people, equipment and money to get the job done.

Everyone's looking for leadership. Almost every magazine and newspaper heralds the search. Some scholars say they know what it is, some scholars say they know what it isn't. In one university library I found almost 200 books on leadership. What is this recognized, yet unrecognizable thing we call leadership? If you know, please share it with us.

(CALL FOR DEFINITIONS FROM AUDIENCE; DISCUSSION)

What Leadership is Not

Now let me tell you what leadership is *not*. It is *not* necessarily the person at the top of the organizational chart or pyramid. Leadership should not be confused with "the leader." I do not want to talk about leaders, about presidents, about directors, or kings, or queens. Those people are there by election, appointment or succession. Some leaders have leadership, but it can be measured only at the *conclusion* of their terms, when they - or others - look back at what they made happen, and how productive their term or reign was.

Leadership can be found at any level of the charts, at the top, halfway down, or at the bottom. Since leadership is impartial, it will not be identified by an organizational chart.

Just as leadership is not found just in the person in charge, nor designated by the hierarchy of the organization, neither is it defined by types of management: X, Y or Z, scientific management, country-club management, or autocratic management. If we look at the history of management, we see the change in leadership styles. In the 1920s and '30s, a hardnosed leadership style was in vogue: you either turned the crank in the factory or you got fired. In the late '30s and the 1940s human relations management was introduced - you know, how's your wife? how's the kids? how're you feeling? now get back to work. After the war - in the 1950s - it was the biggest bang for the biggest buck, and pressure, pressure, PRESSURE! Next it was situational management - you had to have management skills plus personality, and be able to get along with all the people. And from the '70s on up we talk about management in which leadership has to be a factor: management by consent. Management is transitory, and dependent on leadership, but management is *not* leadership. Yet leadership has a place in each of these systems of control, because leadership is the ability to influence other people.

Who Do You Want to Influence?

I have a question for each one of you, and I want you to write down your answer, please. *Who do you want to influence?* When you think of productivity in your job, who do you want to motivate? How many people do you want to motivate? How many would you like to influence? Who are they?

Put yourself, for a moment, at an average university, or college campus, and imagine who you would want to influence. The administration, of course. Administrators make the means available for people and materials. How about the faculty and the faculty senate, and the governing body? How about the student government and the newspaper? How about the alumni? Do they all want a say about what you do? How about your campus neighbors? If you overlook any of them, you are missing an opportunity for using leadership in your role in influencing people.

Most people associate productivity with influence on the people who work for them. I feel that I have a bigger challenge in influencing the people for whom I work, which include all of the above-named groups as well as all the people who are on the supply or service end (who are the ones that really get things done).

In our department, on our campus, new supervisors are given the academic catalog to study. In the facilities or physical plant business our job is service; you will find what services are needed in each department by reading the course descriptions. Do you need fume hoods? Chemical disposal facilities? Humidity and temperature-controlled laboratories for plants and animals? Computer banks? What are the parking requirements? Storage requirements? Dormitory and gymnasium requirements? Recreation facilities needs?

We share needs for funds with the Dean's Council, to show the members how our budget may fill their needs. We seldom refer to "physical plant" on my campus - we refer to ACADEMIC FACILITIES. That puts the needs in proper perspective. I meet regularly with the Dean's Council, which is composed of representatives from all colleges. I will give you an example of how sharing our budget with them resulted in positive influence. Last fall we anticipated a declines of 100 students in admissions. The possible loss of revenue amounted to $1 million at this private institution. One dean suggested that the colleges share the cuts, with NONE being taken from the facilities budget for campus upgrading. I use this as a case in point to show the effects of influence through sharing information in order to get the means that, in turn, affected productivity. That leads to a second question: Who do you think tries most to influence you?

Who Has the Most Influence on You?

Who has the most influence on you in your job? Is it the people who work for you? Those for whom you work? Your colleagues?

For those of you who proclaim that you have the greatest job in the world because your boss never bothers you, I have a word of advice: make an opportunity to influence him. If you want to affect your productivity, if you want to affect your means, remember that the people you work for have the strings on the resources you need. I want the people that I work for to know about the problems I face. It is their academic programs we are trying to support. They supply the means - and the approval - for our programs. They share our success or failure, and success depends on leadership ability.

Identifying Leadership Ability

How can people who have leadership ability be identified? Well, of all the books and articles published, of all the studies and surveys undertaken, several distinct methods emerge. One that has been used frequently is observation of successful people. We can study their behavior: what do they do? what methods do they use? Or we can study their personality traits that contribute to leadership ability: what triats do they possess that allows them to influence others successfully?

I have a few of these traits here. I'm going to distribute them and ask you to discuss them in relation to their effect on productivity. Then I'm going to ask each group to share the results of your discussion with the rest of the audience.

(THE TRAITS DISTRIBUTED TO THE AUDIENCE ARE: KNOWLEDGE, LOYALTY, COURAGE, INITIATIVE, JUSTICE, DECISIVENESS, TACT, DEPENDABILITY, JUDGMENT, ENTHUSIAM, UNSELFISHNESS, INTEGRITY, ENDURANCE, BEARING, PERSEVERANCE. DISCUSSION

FOLLOWS, FIRST IN SMALL GROUPS, AND THEN WITH THE GROUP AS A WHOLE.)

If you wish to describe the person who most influenced your life, you would probably use several, but not all, of these traits. Similarly, if you were to choose which traits best described the chairman of General Motors or General Patton, you would different strengths and weaknesses in their leadership.

(PASS OUT CARDS)

On the cards being passed out I would like you to indicate which of these traits (REFERRING TO THE DISPLAY) is most descriptive of you - only one. Then state which is least descriptive. Tough, isn't it?

We could use another list of adjectives; there are many others that would be suitable. The point is that, in order to influence another or others, you first have to identify your strong and weak traits, and theirs.

(CARDS ARE PASSED IN, NEW CARDS ARE PASSED OUT)

On the second card, which is being passed out, I'd like you to write down the one word that best describes this group. You can do it - you've been meeting for business or pleasure for at least two days now, and most of you have known many of the others over a period of years. Be honest: what do you really think?

Now, two more perspective for identifying people who exercise leadership: bearing and communication. Leadership is expressed through bearing. How do you stand? How do you move? Purposely, from point A to B, with an objective in mind, or idly? How do you dress? Whan do you arrive at work? When do you leave? How are your employees influenced to act toward arriving at work on time, and starting the day, through your bearing? Is your exchange with them friendly, formal or cut? Have you altered your vocabulary to meet the demands of the newer, non-evaluative terms? "Superior" and "subordinate" is no longer used, the theory being that no person is "superior" to another - we now have "managers" and "non-managers." We no longer call a thing "right" or "wrong", or "good" or "bad", but we point out "alternative" ways of doing things, some being more "appropriate" than others. A slip of the tongue can result in a union grievance or a civil rights suit. Pointing a finger at a worker can result in a charge of harassment. We must be forever alert about what we say and do.

On the other hand, we must not lose our moral courage to put unpleasant facts on the table. At times it may take more guts than physical courage to tell your President the real honest-to-goodness condition of your facilities. He may not want to hear it, he may not understand how and why things have reached their present state, he may put the responsiblity squarely on your shoulders and your job on the line. Don't just tell him: show him, too. It may have been years since he walked through some of the remote corners of the campus, basement storage or attic lofts. He may have seen only the cosmetic side of improvements, renovations or expansions. He may not be aware of how much has been done to improve safety and bring the facilities into compliance with current building codes, or how much still needs to be done. Present him with areasonable, realistic plan that can be implemented while maintaining essential operations.

Leadership Applied to Problem-Solving

Merely having the ability influence people up and down the line is not leadership unless we intend to lead them in a positive direction toward the goals and objectives we have set. Having identified leadership and its ability to effect actions, we must look at how leadership can assist us in finding and implementing good solutions to the problems we face, or the challenges we choose to meet. If you are going to solve problems, you first have to be able to recognize them. How many of you can cite band-aid fix-ups on your campuses that didn't get at the heart of a problem that needed surgery? Or a problem that was ignored in the hope that it would go away or that Divine Providence would intervene to solve it? Well, first you have to recognize that you have a problem, identify what it is and its extent. Is it a simple problem that can be solved by merely reversing the order in which it was incurred until it is erased? Or does it stand alone? Or is it symptomatic of a larger problem? Why fix a pothole when the road needs paving? Pinpoint its source: is it a people problem, a materials problem, or a money problem?

If the facing on a new building shows premature aging, is it the result of poor workmanship, shoddy materials, poor design, inadequate specs or budget-cutting? Once you have identified the source, all possible solutions should be listed, without priority or evaluation. Then go through the solutions one at a time, ordering them from best to worst. Reconsider them in light of your limits - high and low. Finally, reconsider them still another time in terms of feasibility: time, money, and available craftsmen, in-house or by contract. Few problems have perfect solutions: most solutions are compromises. Through leadership, you can see to it that the best possible solution is found in the time available. We seldom have the time to gather all the information available, and if we waited to gather all the information, nothing would ever get done. We must influence others to give us good information. Leadership involves decisiveness: choose the best possible solution based on available information. My own philosophy is, "A good plan well-executed is better than the perfect plan never started." Through doing productivity will be achieved.

Now let's turn to leadership and timeliness. How many people who are here have a complete, functioning, energy-conservation plan on your campus? (CALLS FOR SHOW OF HANDS) Good! Now, let's see . . when did the energy crunch occur? 1968? 1969? Fifteen years ago? Some of us haven't completed an energy conservation plan yet. Consider this example. Bradley University was spending $4,000 to $5,000 per day on energy. The campus had about 30 electrical meters, each with a rachet demand charge. A quick calculation showed that a saving of $125,000 per year could result from going to a single meter. A plan was on file; it was a plan with the local utility company that have never been finalized. It was a seven-year plan that indicated the improvements that would be made gradually until a new electrical system with one meter was installed. Overhead lines were to be removed and placed underground, enhancing the campus aesthetics. But there was one big snag. Campus enhancement was already underway and we had a landscaping plan that was to be completed this year. Would the seven-year plan of moving utilities underground destroy this progress? Yes. The question became, How can leadership be used to reconcile this conflict?

Our yearly bill for energy from this company was $1 million for electricity, $987,000 for gas. I figured that was enough to get their attention, and arranged for a meeting. They showed us the seven-year plan. We observed that it seemed like a complicated plan, and asked, Could it be simplified? We talked it through, made some changes here and there, and came up with a plan that could be completed in six months! By doing it in six months instead of seven years the price dropped from $2.8 million to $1.5 million. We took the plan to our Board of Trustees. They agreed, "It's a wonderful plan, but . . . . we don't have $1.5 million." We asked for permission to discuss arrangements for payment with the utility company. Doubtfully, they consented . . . .

Work commenced on 1 November last year. The campus has been restored; underground utilities and new landscaping is now in place. To make a long story short, the utility company is financing this project, and their generous donation to the university relieved us of further expense. Making it work involved a whole lot of people, but we made it happen. Leadership is action, and it effects action. In exercising leadership, you can make things happen, but in order to do it you have to know how to communicate.

Leadership and Communication

Communication, like leadership, is everywhere. How many empty chairs do you see in this room? Empty chairs tell us something. Should someone be in those chairs? Is the front row empty because no one wants to sit there? Why? Did we fail to ask somebody who should be there? How often do you really keep your people informed? Do you have a regularly scheduled meeting time? As costly as it is (our school being a small campus) once a month all the employees of our department meet together. They hear about what's going on at the university, whether or not it directly relates to them: new buildings in the plans, trustee decisions, projected enrollments. They are ambassadors of the university wherever they go, and they can proudly share in the decision to remodel the library, or turn an old church into a music hall, and they can relate their jobs to the school's goals.

Open communication is a necessity for physical plant and facilities managers. Know your staff by name. Be interested in them. Share their successes, listen for their concerns and their ideas. Observe their attitudes toward work and toward each other.

How do you listen to employees who come into your office with a head of steam? I use the "walk and talk" method. First of all, we get out of the office and into a more informal setting. We walk, and talk, and I listen. We walk until we get at the heart of the problem, and nine times out of ten we can work it out. Open communication influences that relationship.

You have to communicate that your job is as important as any job on campus, including that of the President. It you don't believe it, show it, act it - no one else will. I refer to the three groups on campus: staff, faculty and students. Which is most important? They all depend on each other; none is more important than another.

A few years ago the president of Brigham Young University said that many students still come from families in which the parents did not go to college. They could not evaluate the merits of the school by questions put to professors, or the technical jargon on the pages of forms to be filled out. They look at the campus, the dorm rooms, the cafeteria, the landscaping, the impression of order and caring. That's the productivity of your leadership that's showing - that results in new students. And that's communication!

Leaders and Managers

By appointment, you are directors, or managers. I would suggest that there are many managers and directors who are also leaders. I will help you identify the differences between a manager and a leader or, if you will, a manager who uses leadership effectively.

A manager strives for order; leaders tolerate ambiguity. A manager goes by the book, computer printouts, written descriptions. A leader doesn't wait until the plan is firm: he's thinking out ahead. A leader anticipates change. He will be aware of the need to change a classroom to a computer room long before it occurs to the academic faculty to make that need known to him. He has to be out ahead, he has to deal in things that are not firm.

A manager tries to correct failures; a leader turns failures into successes. A manager depends on the system; he believes it will work best when followed carefully. A leader will adapt a system to allow people to work freely within it.

A manager attempts to adjust change; a leader attempts to produce change.

A manager tends to be result-oriented; a leader tends to be goal-oriented.

Informal Survey Results

Now let's see how you rate yourselves and the group in terms of leadership. The last time I used this exercise the individuals in the group felt that their strongest leadership quality was dependability, and their weakest was tact. In other words, they felt they could be counted on, but don't always way the right thing at the right time. As a group, they felt that knowledge was their most important leadership asset - technical knowledge, knowledge of management practices, knowledge of people, knowledge that can influence their colleagues, those who they work for, and those who work for them. They rated the leadership trait that least applied to the group as tact. So, collectively, they still don't know how to say it. There's a little lesson here for the person who would try to influence another in that group: both parties know that the other has no tact, but one thinks the other knows it all, and the other thinks the first is very dependable. They must adjust their communication accordingly.

Now let's see what you think of yourselves, and the group as a whole, regarding leadership traits . . . .

(ANNOUNCEMENT OF STRONG AND WEAK TRAITS, AND DISCUSSION)

Summation

If you believe that productivity is based on people, money and equipment, and if you are concerned with it, and if you believe that leadership is the ability to influence others, I want you to picture in your own mind who it is on your campus that you want to influence. Is it the president or a custodian, one of your supervisors or an academic dean, the man with 35 years seniority or the newest assistant? If it's any, or all, of them, how would you go about influencing each of the ones you've singled out? They are all different. My suggestion is that you just reach over here, get a cupful of leadership, pour it over all just like the dressing on a salad, mix it all up and you will have a productivity salad. That's what leadership is - the oil that makes machinery run in an easy and comfortable way.

Thank you.

Selecting and Working with Architectural and Engineering Consultants

John M. Davis, AIA
Associate Director for Design
Office of Facilities Planning
and Construction
The University of Texas System

The quality of the professional design services provided by the architect and engineer is the single most important factor in determining the functional success, construction costs, and life-cycle costs of a university building. Since design services represent only a small percentage of the total project budget, it is in the best interest of the university to see that the most qualified firms are selected for its projects.

It is estimated that the initial cost of some buildings with a 40-year life is only one-seventh of their life-cycle cost. Professional design fees are only a small percentage of construction cost and a much smaller percentage of life-cycle cost. Yet the architect/engineer design team has the opportunity to contribute expertise in energy-efficient, value-engineered designs that have dramatic effects on maintenance and operation costs every year.

The U. S. Congress established as federal law the "Brooks Act" in 1972 (Public Law 92-582) with the requirement that architects and engineers be selected for federal projects on the basis of their qualifications, subject to negotiation of fair and reasonable compensation. Most states and numerous local jurisdictions use Brooks Act procedures with the selection method of negotiating a contract with the firm most qualified to provide the service.

If your institution is planning to remodel existing or construct new facilities, you should know the laws applicable in your state to the architect/engineer selection process. What jurisdiction will the university have over its project, and how can Physical Plant contribute to the planning process?

The Brooks Act established an agency-based selection system for federal projects which is also used by many local governments. Three basic elements of the agency-based selection system are:

1. Public announcement of intent to award a commission;
2. Review of qualifications and ranking of a number of eligible firms on the basis of demonstrated competence and ability; and
3. Negotiation of a fair and reasonable fee with the most qualified firm.

The selection board method also incorporates the three elements of the federal law, but the procedure is conducted by a selection committee often comprised of public members, registered architects, professional engineers, and public officials in addition to the user-agency or university representatives. There is no single selection system that is best for all jurisdictions. However, experience has shown that the agency-based system and the selection board system are the most effective for obtaining the most qualified firms to design university projects.

While the agency-based selection procedure is in use in approximately one-half of the states, the selection board method has been adopted by Massachusetts, Pennsylvania, Minnesota, and Louisiana. Because regulatory agencies implementing these laws often have substantial leeway to interpret intent, you must become familiar with the laws that apply to your project.

Procurement officers might ask, "Why not contract for architectural and engineering services on a competitive bid basis?" Why have the federal government and many states formalized their procedures with laws that specifically exclude A/E procurement from competitive bidding requirements?

Public-sector building projects involve public health and safety considerations. The agency that builds a facility is responsible for obtaining the best possible project with the best available design services for their money. The scope of professional design services cannot be defined like the purchase of goods on a competitive-bid basis. Many intangibles such as technology, design talent, and construction management skills are difficult to compare. The principal reasons for selection based on qualifications and negotiation are; the lack of a definitive scope of work, and the importance of selecting the most qualified firm. In addition, the user-agency has the responsibility to see that the selection process is free from political influences.

While laws will differ from state to state, most will provide for a public announcement or request for proposals, submittals by interested firms, and evaluation criteria.

The public announcement or request for proposals should include a description of the type of project to be designed; the scope of services required; construction budget and schedule; evaluation criteria; and submittal requirements.

Many agencies have adopted the use of standard forms for architect/engineer submittals. The General Services Administration Standard Form 254 provides a profile of the firm's size, experience, business volume and area of specialization. Form 255 details projects of a similar type and gives qualifications of personnel who would be assigned to the project. It is important that qualifications be submitted and evaluated for all consultants that make up the design team. The architect's office may not have in-house engineers. Therefore, the proposed consulting engineers should be scrutinized to the same extent as the architect. Other specialized consultants may be required on certain projects for such things as food service equipment, acoustics, audiovisual equipment, and computer installations.

The selection process is only as good as the evaluation of submittals. Inquiries to previous clients can help establish a firm's ability to perform.

This also provides an opportunity for Physical Plant to participate. While faculty may ask questions about adherence to program requirements, and business officers ask about budget control, the Physical Plant Director should inquire about maintenance and operation track records.

Interviews may be conducted with a limited number of firms after evaluation has identified those best experienced and qualified for the project. The key personnel who would actually be assigned to the project should appear at the interview. This allows an opportunity to compare approaches to the design process, interpretations of program requirements, and personal styles of key professionals in each firm. If time permits, tours of previous projects can also be very informative.

Following evaluation, ranking of the top three to five firms might consider such things as experience relevant to project, design ability, demonstrated interest, understanding of program requirements, availability of key personnel, and schedule and budget performance record.

Negotiation of the A/E fee completes the selection process. Some institutions may mandate the method of compensation. For example, The University of Texas System Board of Regents has approved a fee schedule based on a percentage of construction cost and technical difficulty. Other methods of compensation such as cost-plus-fixed-fee or a lump sum fee may also be used. Of importance to the Owner is a clear understanding of the scope of services covered by the fee agreement. A negotiated low fee may reflect a reduction in basic services. Attempt to define as thoroughly as possible the total service required before negotiating the fee. If this cannot be done, negotiate a fee for basic services and establish a method for calculating fees for additional services should they arise later. Always determine the fee basis before the service is rendered.

If agreement on the scope of services and compensation cannot be reached with the first ranked firm, negotiations are terminated and the Owner enters into negotiations with the next ranked firm. This process continues until an agreement is reached.

Some of you are listening to me patiently, and for that I thank you. Others are thinking that I am wasting my breath because the architect/engineer evaluation and selection process includes only the highest administrative officials on your campus and not the Department of Physical Plant. It is on precisely this point that I would like to redirect your thinking. The theme of the 72nd Annual Meeting of the Association of Physical Plant Administrators is "Professionals Working Together." This underscores the national trend of evolving Departments of Physical Plant headed by qualified professional administrators. On a major campus today, the Director of Physical Plant is more likely to be a professional engineer than the stereotyped maintenance foreman of a decade ago.

I know there are pockets of resistance where university officials are not yet sensitive to the concerns of Physical Plant in the facilities planning process. I also know Physical Plant Directors more qualified than University Presidents to answer some of these questions. Every university mission statement should have an academic role and scope and a campus facility master plan. These must be developed by professionals working together.

I encourage you to seek out this responsibility. The Director of Physical Plant, or his designated representative, should serve as a member of the facilities planning team. This will assure early input of concerns for low maintenance, energy efficiency, life-cycle cost, security, life safety, control and monitoring systems, handicapped access, and any number of other things successful projects must provide. The architect/engineer selection process is just the tip of the iceberg. It is just the start of an association that will last the life of a building.

Once Physical Plant representation has been integrated into the facilities planning team, opportunities for contributing to the success of the project abound. Evaluation of the campus master plan must take place early in the process to identify alternative sites for the proposed facility. In evaluating site selection, an environmental impact assessment is done. Among other things, this might include the following: preservation of natural surroundings, access for vehicles and pedestrians, parking, utility services, and civil engineering concerns.

The need for a major project does not materialize overnight. Program requirements normally develop over an extended period of time. Physical Plant is not expected to supply the academic justification for a project. However, early involvement of Physical Plant with Faculty and Administrative Planners can result in a more realistic program statement.

To progress from a simple list of rooms to "net assignable square feet" and ultimately to "total gross square feet" is a critical process. How much area is devoted to partitions, mechanical rooms, chases, restrooms, stairways, elevators, corridors and other public spaces? Does Physical Plant require access for maintenance, janitor or supply rooms, service elevators or truck docks? Questions such as these are frequently overlooked in the early planning process. Program requirements have a way of developing into project budgets, and once those numbers are set, changes are very difficult. After so many hours around the conference table, someone of authority will say, "50,000 square feet multiplied by $60 per square foot is $3,000,000." This, of course, is an oversimplification, but it happens more often than we care to admit. There are many ways to solve a problem, but once the program requirements and the budget are set, flexibility is diminished. If Physical Plant requirements are introduced after the program is set, they will compete with the academic requirements. This is a "no win" situation.

Factors other than square feet will impact the cost of a project. One site option may have all utilities available. Another site may require expensive utility extensions. The least expensive air conditioning system over the life of the building, may not have the least expensive first cost. Life-cycle costing is recognized as a valid concern for university facilities. A modest investment may pay back in a short period of time with today's utility cost. The most maintenance-free material may not have the least expensive first cost. This pay back will become a factor in the Physical Plant M&O budget.

The term "value engineering" has been given to the exercise of evaluating the most cost effective way to accomplish your planning goals. The architect/engineer can help you explore the various methods and materials available to construct your project and the costs associated with each. Trade-offs are inevitable, but requests made early in the planning process have a better rate of survival than those made at the last minute.

If your request cannot be accommodated in the project, there may be a way to work out a partial solution or plan for its future addition. As an example, the larger components of The University of Texas System have been able to justify a central Facilities Control and Monitoring System (FCMS) for Heating, Ventilating and Air Conditioning. It is very expensive initially to install this system campus-wide. It may be possible to install the central hardware package as phase one. Major remodeling and new construction projects would then have line items in their budgets to monitor points within these facilities and bring them to a building interface panel. Existing buildings may be added by priority as part of the Physical Plant budget over several years. If the project budget cannot fund this request, inexpensive conduit may save substantial amounts of money when the system is added later. This monitoring system can be expanded beyond HVAC to include security and fire alarms, elevators, environmental control rooms, freezers and refrigerators, and any other critical point on campus. If the budget will not support the complete system, perhaps part of the system should be an alternate bid. This will identify exact cost when the project is bid. The University then has the option to award this additional work if funds are available. At the very least, such a system should be designed for future addition and expansion.

Flexibility determines the useful life of a university building. As teaching methods, research trends, and technology change, so must the buildings that house them. If you customize twenty offices, ten classrooms, and five laboratories, you may as well make out thirty-five physical plant work orders to change them. Change on the university campus is inevitable, and flexibility is the vehicle for change.

Some of the best design engineers in the country have no experience in the maintenance of the equipment they specify. Pulling a transformer from an inaccessible vault is the price you may pay for this oversight. If you must crawl through a maze of pipes to change a filter, it means the filter will not be changed. The Department of Physical Plant should impress upon the design engineer the need for adequate access for proper maintenance. How many buildings on your campus would you design differently if you had the chance? Do not miss your chance on the next building or remodeling.

Once you have stated your requirements, can you have confidence that they will be incorporated into the building design? On some items and with some A/E firms you can. To protect your interests, you must follow through by participating in the review of the building's design, the final plans and specifications, and even the construction process.

Normally the A/E will submit the project for the Owner's review at various stages of completion. As an example: schematic plans, preliminary plans and outline specifications, fifty percent or seventy-five percent complete construction documents, and final bid documents should be submitted. The Department of Physical Plant needs to continue its effort by participating in these reviews. Look specifically for items previously requested, and expect to find many more items not previously thought of or adequately addressed. The process is time-consuming, but the investment is great and the results are worthwhile.

What will Physical Plant look for during the review process? We have already mentioned heating, ventilating, air conditioning, electrical and plumbing systems design, and maintenance accessibility. Life safety requirements might include means of egress, alarm and sprinkler systems, and fire department access. Security may involve closed circuit television, alarms, exterior and interior lighting, and a keying system compatible with other campus buildings. Barrier-free access and special toilet room accessories for the handicapped are required by national and state laws. Standardization of toilet room supplies, housekeeping supplies and equipment, plumbing and lighting fixtures, building graphics, and hardware can result in savings. Low maintenance landscape can be achieved with hardy native plants.

A new facility, without question, will impact on the Physical Plant M&O budget. New personnel required for housekeeping and building maintenance must be part of the budget planning process. Utility cost must also be forecast. Dates for completion of construction and occupancy of the facility must be accurately projected to avoid M&O budget problems.

It may be worthwhile to explore other budget line items outside of construction cost to avoid additional Physical Plant expenses. Is it possible to include the cost of new housekeeping equipment within the building's furniture and equipment budget? A stock of critical spare parts and an emergency generator may be justified for a research facility.

Once construction starts, Physical Plant involvement should continue. Contractor's access, parking, and material storage must be addressed. The contractor must be supplied with utilities during construction. All utility shutdowns must be scheduled. Physical Plant will want to review certain shop drawings from the contractor. Any requests for substitution of materials should be closely evaluated.

All attempts should be made to minimize change orders during construction. Thorough review of plans and specifications prior to bidding will go a long way toward accomplishing this. Owner requested changes can result in dramatic cost increases. If a project is under design for one year, and under construction for two years, it will span three years of changes before its doors open. Presidents change, deans change, department chairmen change, faculty change, and even Physical Plant Directors change. This often results in requests for changes to the building while it is under construction. Construction change orders are not cost effective because they must be negotiated with the contractor and are not subject to competitive bidding. Physical Plant should follow all change requests to see that the intent of the original design is not lost and to see that other budget line items are not diverted to pay for the changes.

Advanced planning must be given to all items that are to be accomplished outside the construction contract prior to occupancy of the facility. This will vary among institutions and between projects. Furniture and equipment must be purchased and installed. This might also include carpeting, window coverings, graphics, and telephones.

Physical Plant should play a part in the inspection of the contractor's work, preparation of a "punch list" of incomplete items, and the acceptance and occupancy of the facility. This will signal the start of the warranty period and the actual move-in operations.

The contractor should provide Physical Plant with a set of as-built drawings showing all changes during construction. A complete set of manufacturer's literature, warranties, and maintenance schedules should also be provided. Physical Plant should see that all defects are reported to the contractor for correction during the warranty period.

Comprehensive facilities planning will involve Physical Plant from start to finish. The effort is time-consuming and difficult, but the results can be long lasting. A new facility can be a source of pride to faculty, students, staff and community. Physical Plant can share in this pride when it knows that its participation is reflected in the final product.

Upgrading The Campus District Heating And Cooling System, And Selling Energy Off Campus.

Richard E. Eckfield
President
North American District Heating and
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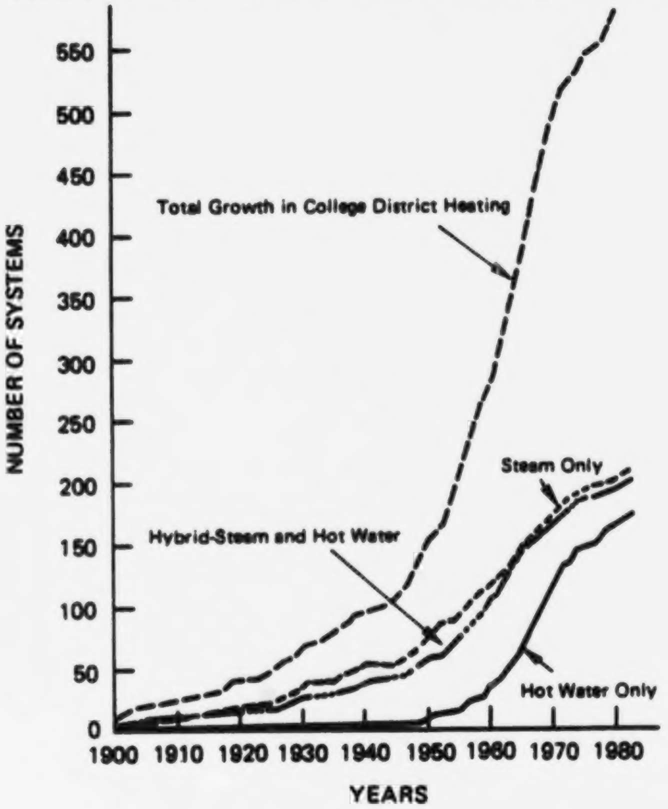
Washington, D.C.

Good Afternoon. On behalf of the members of the North American District Heating and Cooling Institute, I want to express our extreme pleasure that this workshop on district heating and cooling is taking place. Almost two years ago we approached the staff of the APPA with an idea. The idea was that our two Associations could help each other achieve their mission through collaboration.

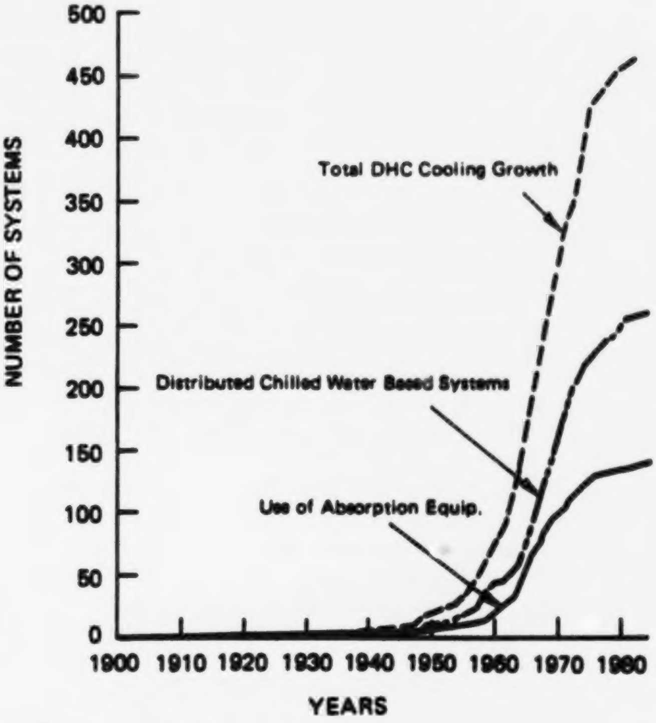
Our mission at NADHCI is to promote the expanded use of district heating and cooling and combined heat and power (DHC/CHP) in North America, and in the process to see to the technical and professional needs of all parts of the DHC/CHP industry. APPA's mission, as you know, is to help the Physical Plant Administrator run the campus in the most efficient manner possible. Over the past several years the members of your present APPA staff, as well as your former staff have agreed with us on the compatability of our objectives. From those agreements have come a series of joint efforts. I would like to take this time to acknowledge the valuable contributions which were made over the past two years by both Paul Knapp and Chris Crittenden, who have both since left the APPA staff.

With Chris' help the APPA and NADHCI jointly conducted a survey of DHC use on college campuses during the summer of 1983. We received data from 744 Universities and Colleges. From that data we were able to profile the first comprehensive picture of the growth of DHC in the college setting. What we learned was (1) the growth of DHC in this setting was very much a post-WW II phenomenon, (2) that the use of hot water as a thermal medium gained rapid acceptance after 1950, and (3) cooling, both in the form of distributed chilled water and the use of absorption air-conditioning was a post-1960 phenomenon.

The following charts produced from the APPA-NADHCI survey data gives the profile of both these district heating, and district cooling developments.

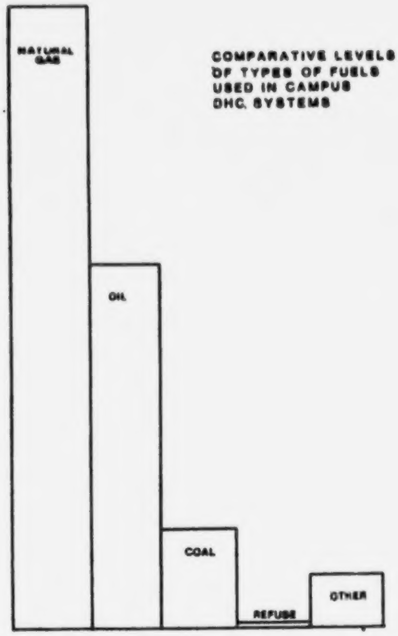


Upper Chart shows growth of district heating on college campuses. Chart below shows growth of district cooling. Both charts were first published in NADHCI WASHINGTON LETTER October 24, 1983.



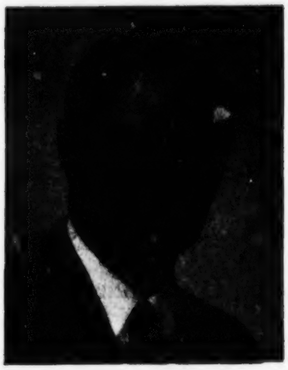
The second valuable data set provided by the APPA-NADHCI survey showed the overwhelming dependence on heat-only boilers in campus systems, boilers which were primarily natural gas or oil-fired.

Of those reporting in our survey regarding this item, 250 reported using oil; 433 reported using natural gas; 65 reported using coal; 2 reported using refuse; and 39 reported using "other" which included use of propane, wood residue, and electric boilers. Only 47 reported that they had a combined heat and power (cogeneration) facility in operation as a heat source.



From the survey data and other data available to us, we began to realize that almost half of the boilers in operation on college campuses, and close to half of the people who were operating them, were reaching their normal retirement age, or would do so within the next decade.

Since NADHCI's mission is in part to promote the expanded use of DHC/CHP what this data suggested was that there was a golden opportunity on the college campuses to improve the heat sources for these systems by switching them to less expensive fuels such as coal, and/or by introducing combined heat and power operations, or by doing both.



The University as A Utility: The Virginia Tech Story

By B. Gordon Watkins, Jr.
Vice President
Wiley & Wilson

It may seem unusual for a University to serve the electric power needs of the town that surrounds it. Yet this is exactly what Virginia Polytechnic Institute and State University does for the Town of Blacksburg, supplying part of the power needs of the town from the college-owned cogeneration plant.

What started out shortly after the turn of the century as an electrical engineering professor's project for the primary benefit of his students has evolved into a modern power system which demonstrates a unique cooperation between the University and the Town. This professor installed a small turbine generator in the steam plant and strung wires down the main street of the village of Blacksburg long before any utility company offered service to the area.

Virginia Polytechnic Institute and State University, like so many state-supported land grant colleges, has seen a spectacular growth in recent years. Founded in 1872, the college grew steadily through the years until the enrollment reached 4,000 students following World War II. Today the student body exceeds 20,000 full-time students. With the growth of the college, the Town of Blacksburg has also grown.

For a number of years the college generated all of the electricity utilized by the college and the town. However, as the school and town grew, the need for electric power increased dramatically. The aging generators could no longer keep up with the demand. With low-cost electric power now available from a utility company, the college began to buy power to supplement the power from the generators. Gradually through the years, locally generated power became a minor part of the total electric service.

In 1971, the firm of Wiley & Wilson was retained to study the feasibility of installing a cogeneration plant at the school. The study recommended the installation of a 6,250 KW, 7,500 KVA, 12.5 KV steam-turbine powered generator. Although state funding for the project was not available, the college financed the project with revenue funds derived from the sale of power to customers in the Town of Blacksburg.

Since the turbine installed exhausts all of the steam into the campus steam distribution system, the capacity of the unit was dictated by demand for the exhaust steam, not the demand for electricity. Therefore, even with the tubine running at full load, it supplies only part of the total power requirements of the University and town. No generated power is ever sold back to the utility company since there is no need to. The peak demand for power at Virginia Tech and Blacksburg occurs during the coldest weather at the time when the turbine is operating at maximum capacity; therefore the cogeneration plant significantly reduces the peak demand charge that the University has to pay the utility company for wholesale power.

The generating system installed is a true cogenerating plant. Steam is generated in a 105,000 pound per hour coal-fired boiler at 600 psig, super-heated to 825°F. This steam is fed into a horizontal multi-stage impulse type non-condensing turbine which exhausts the steam at 15 psig. The exhaust steam is fed into the campus low pressure system to heat all the buildings and domestic hot water on campus. A 1400 ton steam adsorption chiller was installed to utilize this low pressure steam in warm weather to supply chilled water for a campus regional air conditioning system. A single turbine steam extraction at 90 psig with a capacity of up to 25,000 pounds of steam per hour supplies medium pressure steam for cooking and process needs. This extraction is not used in cold weather when all of the steam exhausted can be utilized in the low pressure system, thereby generating more electric power with the extraction port closed. (The medium pressure steam is generated in another boiler).

Operation of this cogeneration plant from 1975 to the present has been successful; equipment has operated as designed. Unplanned shutdowns of the boiler and turbine-generator have been extremely rare. This is due in major part to utilizing proven equipment and having competent personnel operate and maintain the plant.

Since the University serves the entire Town of Blacksburg as a public utility, a separate state-owned corporation, The Virginia Tech Electric Service was set up to manage the electric system. Power is distributed at 12.5 KV through both overhead and underground lines. Power rates to customers in the Town of Blacksburg are basically the same as those offered by the major utility which serves the adjacent areas.

At the present time, the one cogeneration turbine serves approximately 16 percent of the power needs of the University and the Town of Blacksburg. Fifty-five percent of the total load is University power, the remainder is for the Town of Blacksburg.

The firm of Wiley & Wilson is now beginning a study for the addition of more coal-fired steam generating equipment and a second cogenerating turbine at the University.

The fact that a University serves the electric needs of a town of 15,000 people and owns all of the distribution facilities and supplies some of this power from a cogeneration plant may seem unusual and unorthodox. However, for Virginia Tech and the Town of Blacksburg it is a mutually satisfactory and rewarding relationship.

When we looked at the hard realities of campus economics, it became clear that the declining student enrollments plus the tight state government budgets could make such improvements difficult to finance. However, it seemed quite logical that such improvements could be financed by expanding the systems so as to be able to obtain a source of revenue by selling energy; thermal energy or electrical power, or both to customers located off campus.

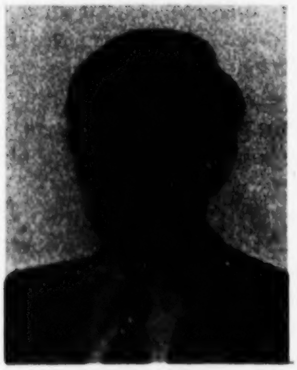
Such expansions, of course, would be completely consistent with NADHCI's city-wide use of DHC/CHP aspirations. To achieve such an expansion scenario, many factors have to be put in place. Accordingly, our Association has taken the first small steps toward working with the College Presidents and the College and University Finance Officers, and with you, the Physical Plant Administrators to share with all three groups the merits of the concept of how campus systems can be upgraded, and such upgrades financed through the sale of energy off campus.

We have found that there is interest in this idea among the College Presidents and Business Officers we approached. Today we would like to review those possibilities with you, the campus Physical Plant Administrators.

To us the college campus DHC system is a potential starting point from which city-wide systems can hopefully grow. As we encourage interest in using the college campus DHC system as a hub for the hoped-for expansion of city-wide systems, we realize we will encounter problems. Some problems we already know of, others are unforseen at this time. Our industry, however, is prepared to help you address whatever barriers may stand in the way of developing city-wide systems. For us, there is a bottom line. That bottom line is the fact that the U.S. and Canada, per capita, are the two most energy consuming countries on this earth. If we are to change this statistic we find that there are only two areas in which systemic changes in our energy consumption patterns can be achieved. One area is the transportation sector. The other is with regard to how we provide our space heating and cooling and domestic hot water production. It is this latter area which can be dramatically improved through the use of community-wide DHC/CHP technology. If such improvements were achieved the benefits would be manifold, and far beyond the mere reduction in energy costs. The ramifications of a successful national DHC/CHP initiative would touch upon issues of national and local economic solvency, our international balance of payments, even our national security, and the potential to reduce tensions throughout the world.

The college DHC systems could be a growing point from which community wide systems can be developed. Over the next several years we intend to continue to explore this potential with you.

What we have assembled here today is a series of presentations which will help present several improvement options to you. These range from squeezing more capacity from your existing DHC system through proper controls, to case studies and financial analyses of how some of your college campus colleagues have approached, or could approach, system improvements and the sale of thermal or electrical energy off campus. We at NADHCI have appreciated the opportunity to pull this workshop together. We look forward to our continuing collaboration with you in the future.



Replacing Campus Heat-Only Boiler With A Cogeneration System Stanford University: A Case Study

Ronald W. Pinder
Cogeneration Applications Department
General Electric Company

In 1984, General Electric's Cogeneration Applications Department placed an ad in several trade magazines that cater to university facilities managers proposing a way for a university to transform "its steam and electricity bills into a student endowment fund." The ad was designed to be an attention grabber and it was, especially in these days of dramatically rising energy costs, nuclear rate shock and other costly woes facing the energy-producing industry.

It might seem an unlikely idea for a university, or any other similar institution, to turn its electricity and steam bills into money in the bank, but that was exactly what GE was proposing. The way to do this -- an answer to counter rising energy costs -- is actually an approach which first surfaced more than 80 years ago. It is called cogeneration.

Cogeneration is defined as the sequential generation of electricity and thermal energy (usually steam) from a single fuel source. Those familiar with the heating and cooling business recognize it under the term district heating. Many of the older campuses around the country have used some kind of in-house generation for years. GE was proposing a way to make these old ideas work in a new, economical way.

Cogeneration came back into the limelight with the passage of the Public Utility Regulatory Policies Act (PURPA) back in 1978. The law required utilities to purchase excess electricity from qualifying facilities at what's known as the avoided cost. The act also required the utilities to wheel power for cogenerators.

Stanford University, located in Palo Alto, California, provides a good example of a large university that is taking complete advantage of the modernization of its existing district heating and chilled water distribution system by installing a new cogeneration facility.

Stanford began evaluating cogeneration in 1982. With the help of Raymond Kaiser Engineers, it reached the conclusion that the university should proceed to build a cogeneration facility on campus, but that if possible, it should avoid using the university's money to fund the project. Once the project got the go-ahead, nearly $3 million was spent for planning and purchasing general and resource equipment for the facility.

Stanford's projected energy consumption for 1986 is shown in Figure 1. Currently, the university meets its needs with a steam boiler for heating and chilled-water production and purchases its electricity from the Pacific Gas and Electric Company (Figure 2). Studies showed, however, that with a new cogeneration system, the university could meets its own requirements and have excess electricity to sell back to the utility (Figure 3).

But since Stanford didn't want to spend additional university funds, a joint venture was structured by GE and Raymond Kaiser Engineers to carry out the project (Figure 4). Named Cardinal Cogen, the joint venture will perform all of the project functions.

GE will design and construct the cogeneration system; Raymond Kaiser Engineers will design and construct the balance of the plant's buildings. The joint venture will own, operate and maintain the new facility, will purchase the fuel needed from PG&E and will sell the excess electricity back to that utility for about 7¢/kwh.

The joint venture will take over the university's existing central energy facility and construct the Cardinal Cogen next to it. Both will be incorporated into the university's total energy system which Cardinal will operate. To make certain that the university's architectural style was preserved and that the new facility would be aesthetically acceptable, university architects were used to design the new building for Cardinal.

Once it is operational in late 1986, Cardinal Cogen will provide 100% of the university's energy needs. In addition, the school will realize some substantial cost savings over the next decade and a half. First, the university will rent the land for Cardinal Cogen to the joint venture at a price equal to a 15% cut in the utility costs. The school will purchase its steam and electricity from the joint venture at the market price. An added benefit is that the university will not have to operate or maintain an energy plant. The projected 15 year savings for the school reach as high as $80 million.

The Cardinal Cogen system will cost $50 million. Two turbines will be used: a GE MS6001 gas turbine, with a 39 megawatt output, and a GE extraction steam turbine capable of a 10 megawatt output. Other major equipment includes a GE main generator step-up transformer, a GE-designed integrated control system and a heat recovery steam generator which will be manufactured by Henry Vogt Company of Louisville, Kentucky.

The GE MS6001 gas turbine to be used is a single-shaft industrial model which is highly efficient and reliable and meets all the high environmental performance standards set by the California EPA.

Financing is an important part of the Cardinal Cogen project. The joint venture is leasing the facility from General Electric Credit Corporation for the 20-year estimated useful life of the project. At the 15th year, Stanford will be allowed to consider changing the arrangement via several options. But again, to get the new facility built, the university didn't have to invest or put at risk any of its capital.

Replacing a heat-only boiler can be attractive if an existing distribution system is in place. For larger buildings or clusters of buildings, smaller packaged cogen units on a building-by-building or a group basis should be considered.

Finally, there is the question of fueling such plants. The Stanford facility is fired by natural gas. But solid fuels are gaining in popularity for cogeneration use. Atmospheric fluidized beds can burn a vast variety of fuels, and these too are finding increased application in today's cogen systems.

Use of solid fuels can open up many regions of the country to cogeneration and these cheaper solid fuels may make some of the campuses in the U.S. prime candidates for cogen today.

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Choosing an Appropriate Leadership Style for Increasing Managerial Effectiveness

Desmond D. Martin
Professor of Management
University of Cincinnati

During the past ten years there has been an increasing emphasis on the importance of good "people management" to the attainment of organizational effectiveness. Best selling books such as In Search of Excellence by Peters and Waterman reinforce current thinking that better organizations continue to stress developing human resources as an important part of the managerial process. Famous and successful companies such as IBM, 3M, and Delta Airlines are all recognized for their progressive programs in human resources management.

In a recent popular book, which I coauthored with Richard Shell entitled What Every Engineer Should Know About Human Resources Management, several steps were highlighted that contribute to increased motivation in organizations. The approach to increasing managerial effectiveness is both influenced and determined by the individual manager's philosophy of leadership. Most definitions of leadership style try to explain or relate the impact of specific styles or approaches of the leader to desired outcomes for the organization, e.g., physical plant department.

In my opinion, there are two common characteristics associated with effective leaders. First, effective leaders are able to motivate their employees to concentrate their productive energies on activities that are highly valued by the organization (physical plant). Second, these leaders are also able to anticipate problems and facilitate solutions (organizational) before these problems reach a crisis stage. Thus, effective leadership involves a broad range of appropriate management attributes and behaviors. Specific steps developed by Martin and Shell help managers understand the practical components of leadership. In view of the current pressure on many physical plant managers for improving productive efficiency, application of these concepts can be helpful. The steps developed by Martin and Shell to raise levels of motivation with brief descriptions of each step follows.

Understanding the Managerial Function

It is the function of the manager to manage the work for the employee and not to actually do the employee's job. The managerial function is essentially a facilitative function which involves planning, organizing, and providing the support needed so that employees can carry out assigned tasks effectively.

There is a tendency for many physical plant managers to fail to delegate, or if they do delegate they continue to try to perform the work for the subordinate employee. This often is seen as interference and reduces job satisfaction and personal development.

Assess the Maturity Level of Your Employees

How employees are managed and how they respond to specific leadership practices is directly related to their own levels of maturity. The more mature employee responds favorably to greater autonomy and challenging work assignments. The less mature employee often does not want additional freedom and responsibility. Mature employees offer greater opportunity to the manager to attain high performance and increased flexibility within his/her department. Thus, part of being an effective leader relates to the maturity level of your department. Whenever possible, managers should design subordinates' jobs that are rewarding and interesting and select mature workers to perform them.

Attainment of Mutual Agreement on Job Expectations

This important step involves managerial discussion with each subordinate that is designed to reach agreement about job expectations for a specified period of time. Reaching agreement with physical plant employees on duties and responsibilities minimizes interpersonal conflict on sensitive areas, and increases commitment to task through personal interaction (involvement). Also, these agreements are essential to good performance appraisals.

Applying "State of the Art" Knowledge of Employee Motivation

This complex step involves a thorough understanding of the need structure of individual physical plant employees, rewards available to the supervisor-manager that relate to those needs, and then linking the need-reward relationship to the performance levels desired. For example, the physical plant manager who rewards good and poor performers at the same or similar levels should not expect that good performance will be sustained or poor performers will improve. Also, physical plant managers often make the mistaken assumption that the only important reward to employees is remuneration. While money is obviously important, there are many other valued rewards, i.e., interesting work assignments, learning opportunities, supervisor approval, etc.

Building a Strong "Helping" Relationship with Subordinates

Every leader during the course of managing people must assume a helping role, but knowing the proper way to be helpful is a complex matter. As previously indicated, a basic part of good leadership is problem solving, but as more subordinate problems are solved by the leader, each subordinate becomes more dependent on the leader. Also, learning and growth are impeded. Good leaders encourage subordinates to solve problems with minimal help and build self confidence and independence within their respective departments. Two management practices that contribute to the attainment of this desired end are first, avoid providing early advice to subordinates and second, avoid excessive use of reassurance or "pat on the back" approaches. Early advice to employees is often based on incomplete information and is not likely to be followed. "Pat on the back" approaches often deny that a problem exists and do not develop problem solving ability.

It is clear from all the above steps that effective leadership requires good communications and interpersonal skills. Communications need to move freely in both directions. It is difficult for many managers to be good listeners. Listening is time consuming and can be threatening to ineffective managers. Yet, through two-way communication both understanding and commitment to task substantially improve. Also, listening skills provide the manager with greater understanding of strengths and weaknesses in his/her department. This knowledge is important, when action is taken designed to improve departmental morale and performance.

Through the communications process, leaders are able to demonstrate both support and consideration for subordinates. An organization (physical plant) climate characterized by supportive communication promotes departmental loyalty. Employees feel better about themselves and their organization. One of the immediate payoffs to the physical plant manager is a reduction in absenteeism among employees.

In conclusion, effective leaders are warm, friendly, and supportive; and their departments exhibit high morale and usually have lower absenteeism and higher levels of performance. Warm and friendly relationships should not become emotionally involved, because emotionally involved relationships raise conflict and interfere with objectivity. While effective leaders are strong facilitators for their subordinates, these actions need to be perceived as a basic part of the leader's style and not a result of personal obligation to the subordinate. Personal obligations increase in emotionally based relationships.

Good leadership practices will greatly improve physical plant performance and satisfaction for both the manager and employees. It should be clear from this paper that effective leadership is a complex matter involving many variables. However, those managers who take time to assess their current leadership style, and the maturity of their employees, and then apply the steps and concepts identified in this paper, will experience favorable results.

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